FRIDAY,MARCH 16,1883,]

INTERNATIONAL STANDARD TIME.

At the last session of Congress, an act was passed, requesting the President of the United States "to extend to the governments of all nations in diplomatic relations with our own, an invitation to appoint delegates to meet delegates from the United States in the city of Washington, at such time as he may see fit to designate, for the purpose of fixing upon a meridian proper to be employed as a common zero of longitude and standard of time-reckoning throughout the globe." The delegates from the United States, three in number, are to be appointed by the President.

The Secretary of State, under direction of the President, has recently sent a circular to the government representatives abroad, requesting them to bring the matter before the foreign governments. The circular states that "The President, while convinced of the good to flow eventually from the adoption of a common time-unit, applicable throughout the globe, thinks, however, that the effort now to be made should be to reach, by consultation, a conclusion as to the advisability of assembling an international congress, with the object of finally adopting a common meridian. He therefore abstains from extending an invitation for a meeting at an assigned day, until he has ascertained the views of the leading governments of the world as to whether such international conference is deemed desirable." The object of the circular is thus to ascertain from each government whether it would accept an invitation "to participate in an international conference at a date to be designated in the near future."

In our opinion, the action of the President is wise. It is better to interest foreign governments in the plan, by asking their opinion of the feasibility of holding a conference, than to request them at the outset to send delegates. The chances are thus increased, that, when the conference does meet, its action will meet the approval of the co-operating governments. There is, however, danger that our representatives abroad will not be sufficiently zealous in pressing this matter upon the attention of foreign governments. It would be unfortunate if the subject should fail because of the lukewarmness of government officials. We hope that scientific men everywhere will make an effort to further this movement by every means possible.

It is announced that Professor Nordenskiöld will take part in an arctic expedition during the coming summer. The Danes, who have for several years quietly pursued arctic explorations in Greenland with praiseworthy energy and notable success, will attempt investigations on the south-east coast of Greenland this summer. A recently received letter states that the skin-boats, or *umiaks*, are now being constructed for the purpose.

The neglect, up to date of writing, of our naval authorities to, in any adequate way, recognize the services to their comrades, and to the reputation of the navy, of seamen Nindermann and Noros of the 'Jeannette' expedition, is exciting unfavorable comment among those interested in arctic matters. Heroism and fidelity into the very jaws of death are surely worthy of encouragement, even without the passport of a commission.

The debates and newspaper comments on an effort recently made in the Massachusetts legislature to prevent the unnecessary and unseasonable ringing of factory-bells in towns and villages, go to show how far we are yet from a practical application of Emerson's dictum, that "the Ought, that Duty, is one thing with Science, with Beauty, and with Joy." We should be glad, in this connection, to call the attention of legislatures to the one conspicuous commandment which modern science has set forth; viz., "You may do what you please in this world, provided you do not infringe upon the rights, the peace of body and mind, and the prosperity, of your neighbor." The justice of this decree is plain to observation; and the applicability of it to the clangor of inopportune bell-ringing is assuredly not

far to seek. We would submit that many easy ways suggest themselves of avakinng a sluggard without need of molesting the sleep of his just, and presumably virtous, neighbour. There be, in manifold variety, clock-alarums, clepsydras, sand-glasses, and galvanic appliances, which are fully competent to privately admonish a slumberer, without any public scandal; not to speak of the old English method, by which an active lad gained a weekly wage by ringing the house-bells of his heavier-sleeping comrades. In one word, there is a right and a wrong in this matter of the bell-ringing, as science has made plain. It is not in the least a question to be determined to-day or to-morrow by the votes of interested parties; for the correct and the final solution of it was written long ago, in the name of eternal justice and the immutable fitness of things.

ON AN ALLEGED EXCEPTION TO THE SECOND LAW OF THERMODYNAMICS.

According to the received doctrine of radiation, heat is transmitted with the same intensity in all directions and at all points within any space which is void of ponderable matter and entirely surrounded by stationary bodies of the same temperature. We may apply this principle to the arrangement recently proposed by Prof. H. T. Eddy[1] for transferring heat from a colder body A to a warmer B without expenditure of work.

In its simplest form the arrangement consists of parallel screens, which are placed between the bodies A and B, and have the form of very thin disks with certain apertures, and the property of totally reflecting heat. These disks, or screens, are supposed to be fixed on a common axis, and to revolve with a constant velocity. For the purposes of theoretical discussion, we may allow this velocity to be kept up without expenditure of work, since we may suppose the experiment to be made *in vacuo*. If the dimensions and velocity of the apparatus are such that the screens receive a considerable change of position during the time in which radiant heat traverses the distances between them, the apertures in the screens may be so placed that radiations can pass from A to B, but not from B to A. It is inferred that it is possible, by such means, to make heat pass from a colder to a warmer body without compensation.

In order to judge of the validity of this inference, let us suppose thermal equilibrium to subsist initially in the system, and inquire whether the motion of the screens will have any tendency to disturb that equilibrium. We suppose, then, that the screens, the bodies A and B, and the walls enclosing the space in which the experiment is made, have all the same temperature, and that the spaces between and around the screens and the bodies A and B are filled with the radiations which belong to that temperature, according to the principle cited above. Under such circumstances, it is evident that the presence of the screens, whether at rest or in motion, will not have any influence upon the intensity of the radiations passing through the spaces between and around them; since the heat reflected by a screen in any direction is the exact equivalent of that which would proceed in the same direction (without reflection) if the screen were not there. So, also, the heat passing through any aperture in a screen is the exact equivalent of that which would be reflected in the same direction if there were no aperture. The quantities of radiant heat which fall upon the bodies A and B are therefore entirely unchanged by the presence and the motion of the screens, and their temperature cannot be affected.

We may conclude *a fortiori* that B will not grow warmer if A is colder than B, and none of the other bodies present are warmer than B.

Since the body A, for example, when the screens are in motion, does not receive radiations from every body to which it sends them, it is not without interest to inquire from what bodies it will receive its share of heat. This problem may be solved most readily by supposing the screens to move in the opposite direction, with the same velocity as before. One may easily convince himself that every body which receives radiant heat from A when the apparatus moves backward, will impart heat to A when the apparatus moves forward, and to exactly the same amount, if its temperature is the same as that of A. J. W. Gibbs.

[1] Journ. Frankl. inst., March, 1883.

PHOTOGRAPHIC FOCUSING.

Considerable discussion has arisen of late as to the propriety of focusing with a large stop, and then using a much smaller one with which to make the exposure. Most of those who have written upon the subject have assumed that it was merely a question of spherical aberration. It seems to the writer, how-

ever, that spherical aberration has little, if any thing, to do with it, as, in lenses constructed on the modern curves, this defect has been practically reduced to zero. If now we take a perfectly corrected, wide-angled lens, and focus it on the centre of the plate, we shall find that the objects near the edges are somewhat indistinct, and by no possible combination of curves can this difficulty be wholly remedied; it is, however, reduced proportionally to the size of the stop employed. It has been shown, by Prof. E. C. Pickering and Dr. C. H. Williams (*Proc. Amer. acad.* 1875, 300), that, with a single lens, a series of concentric circles would be focused on a spherical plate whose radius of curvature was 0.7 the focus of the lens. On the other hand, the diameters of these circles could only be accurately focused on a spherical plate whose radius of curvature was 0.3 of this focus. As far as the writer is aware, no name has ever been given to this optical defect; but for convenience' sake it might be called the *field aberration*.

If the central object on the plate is of the most interest, we shall focus on it, and then push in the plate as far as possible without injuring the central definition, to obtain the best possible result at the edges. Supposing now we insert a smaller stop, the definition over the whole plate will be improved certainly; but, that at the centre having been sufficiently sharp before, we can now afford to push in the plate a little farther still, and obtain better definition at the edges, without perceptibly injuring that at the centre. Therefore, on theoretical considerations merely, we should always focus with the stop we are going to use. But, on the other hand, for lenses of less than 45° angle, or when the illumination is very faint, the practical advantage of a bright image for focusing would more than compensate for the advantages of using the other stop. In practice, for accurate work, the best way would be to determine once for all the difference of focus required by each stop, and then focus with the largest, and apply the proper correction, depending on the stop used.

W. H. PICKERING.

HISTORY OF THE APPLICATION OF THE ELECTRIC LIGHT TO LIGHTING THE COASTS OF FRANCE.[1]

II.

THE Serrin regulator, arranged for alternating currents, has been adopted as the standard lamp. No other apparatus has given better results. Especially with alternating currents, its working is excellent, because the armature of the electro-magnet detaches itself very easily; and besides, as the consumption of both carbons is uniform, the arc remains absolutely fixed.

The machines for generating the current have been of late years the subject of attentive study, which has been unfortunately confined to three types,—the Alliance, Gramme, and de Meritens. The luminous intensities of each of these machines have been measured under carefully arranged conditions. Photometric measurements in such cases are rather delicate. To make them, since the intensity varies in the vertical direction with different heights, a movable mirror is used, which is placed at different heights in the same vertical plane, and which, in each position, throws the rays on the photometer; and thus the average intensities could be obtained. But, as the intensity of the electric light constantly varies, it was necessary to make the observations at one-minute intervals for each position of the mirror. It is not necessary here to go into the details of construction of the different machines; the table below gives the results obtained.

MACHINES.	Number of revolutions per minute.	Horse-power.		Luminous intensity.	
		Total.	Less power used in transmission.	Total.	Per horse-power.
				Carcels.	
Alliance . . .	450	5.18	4.62	275	59.5
Gramme, No. 1 .	550	12.04	11.48	1,010	88.5
" No. 2 .	600	6.01	5.45	493	90.0
" No. 3 .	680	7.06	4.20	342	81.4
De Meritens . .	790	8.06	7.50	536	84.8

It will be seen, that the Alliance machine gives a far less intensity per horse-power than the two others, which are approximately equal. The de Meritens has certain characteristics of stability and solidity which the Gramme machine does not possess; it was, besides, preferred to use alternating currents. For these reasons it has been adopted, and will be installed in all the new lighthouses.

The figures giving the intensity in the preceding table refer to the naked light. When this is placed in a fixed-light apparatus, these intensities become, in round numbers, 12,000 carcels with the Alliance, and 20,000 carcels with the Gramme No. 2. The flashes increase

[1] Continued from No. 5.

the intensity still more. In a scintillating light with red and white flashes there is an intensity

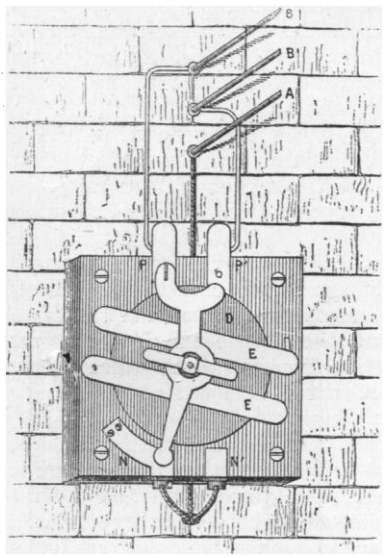


Fig. 2.

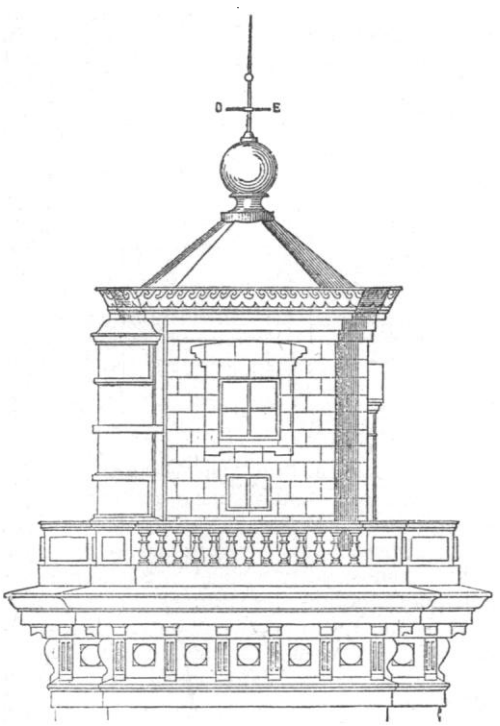


Fig. 3.

of 60,000 carcels with the Alliance, and 110,000 carcels with the Gramme machine; with a scintillating light with groups of white flashes, 90,000 carcels for the former, and 150,000 carcels with the latter. The intensities with the de Meritens machine are about the same as with the Gramme; and 125,000 carcels may be taken as the average intensity when the electric light is used.

Some details will now be given of the installations actually existing, and of those in process of construction; specially describing the lights of la Hève, the first in date to be electrically lighted, and the Planier light, whose installation has just been completed.

The lights of la Hève, situated on the cape of this name and on the top of the cliff, are, from this fact, very elevated: so the towers themselves are not of great height. Both

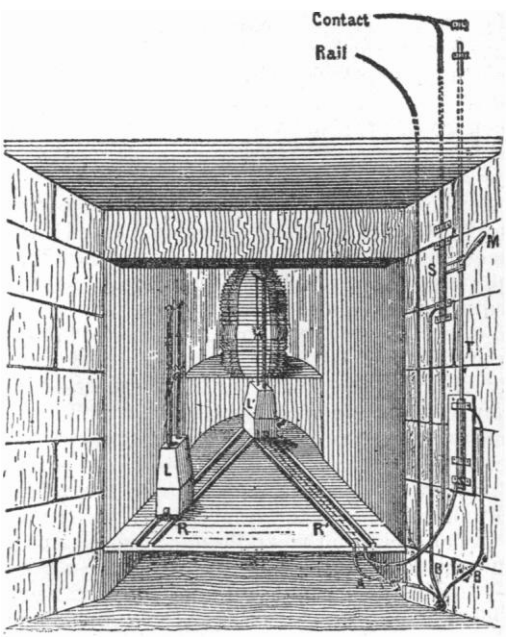


Fig. 4.

towers are square, and are placed about sixty metres apart; between them being the long building containing the steam-power, generators, and quarters for the keepers.

There are four Alliance machines, — two for each light. The two on the left supply the left-hand tower; and the two on the right, the tower on the right hand. The conductors leading the current from the generator are first thick copper rods connected with the commutator, Fig. 2. The rod A communicates with the two similar poles of the two machines, the rods B and B′ being connected to the opposite poles. Ordinarily one machine supplies each light. Thus the current arrives by A,

and, without traversing the commutator, goes by the cable to the regulator (or lamp) ; thence it returns by the second wire of the same cable to N, follows the vertical conductor to P, and returns to the machine by the rod B. If it is desired to use the machine corresponding to

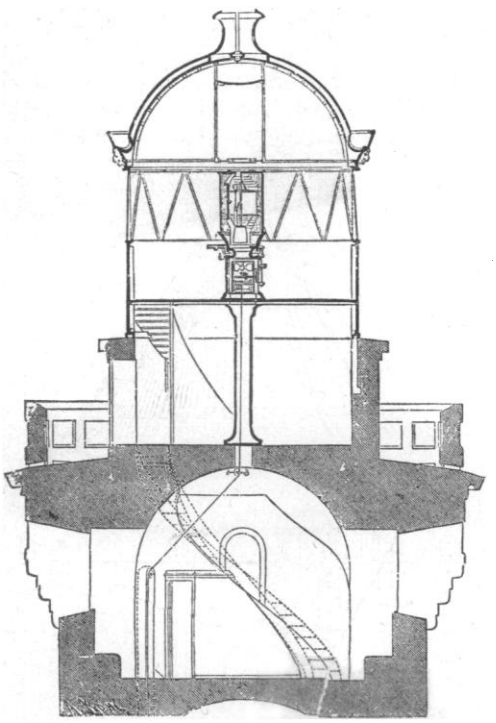


FIG. 5.

the rod B′, the central handle is turned, thus bringing the plate D in contact with P′ instead of P, retaining always the contact at N. In this case the current arrives, as before, at A, goes to the regulator, returns again, but passes this time from N to P′, and thence to the machine by B′.

In foul weather, or whenever it is necessary to increase the luminous intensity, both machines are coupled in quantity. The commutator is then turned until the plates E and E′ are in contact, — the one with P′ and N′, the other with P and N ; the return current flowing simultaneously by B and B′.

The tower of each light is surmounted by a square structure, at one of the angles of which is the optical apparatus. This is clearly shown in Fig. 3. A kind of glass drum closes the open angle of this structure which is in two stories, in each of which is a distinct optical apparatus. The intention of this arrangement is to allow one optical apparatus to be instantly replaced by the other, in order to avoid total extinction in case of accident. In each story, there are two regulators, which can be substituted for each other by means of the crossed rails shown in Fig. 4. The cable with three conductors leading from the commutator, previously described, arrives at the lower story. One of the conductors (A) is connected to the metal platform carrying the rails, also metallic ; the conductor B connects with the sliding rod of the long bolt M T. When this bolt is lowered, it connects the conductor B′ with a wire going from the bottom staple of the bolt to a spring contact under the lamp. The latter re-

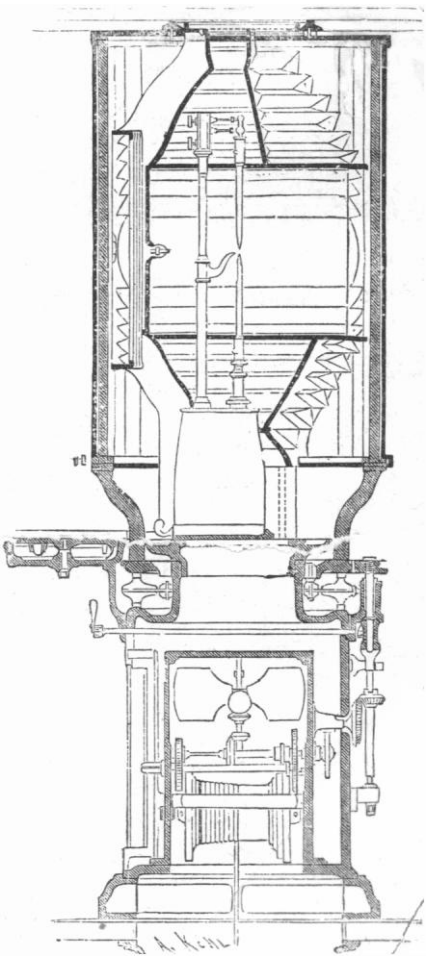


FIG. 6.

ceives the current, partly by the rails, partly by the contact underneath. The wire B communicates with a smaller bolt sliding at the same time with M T, and whose lower staple is connected to the wire coming from the staple of the larger

bolt; so that, when the current passes by B′, it always traverses the lamp, and, when the two machines are at work together, the two currents are united by the connection between the two staples. The upper staples are connected in the same way to the apparatus in the second story; and, when the bolts are raised, the upper lamp is lighted.

The regulators can thus be changed in two ways, — either by drawing the lamp at work back on the rails, and quickly pushing the other one in its place; or by manipulating the commutator bolt, which shifts the luminous

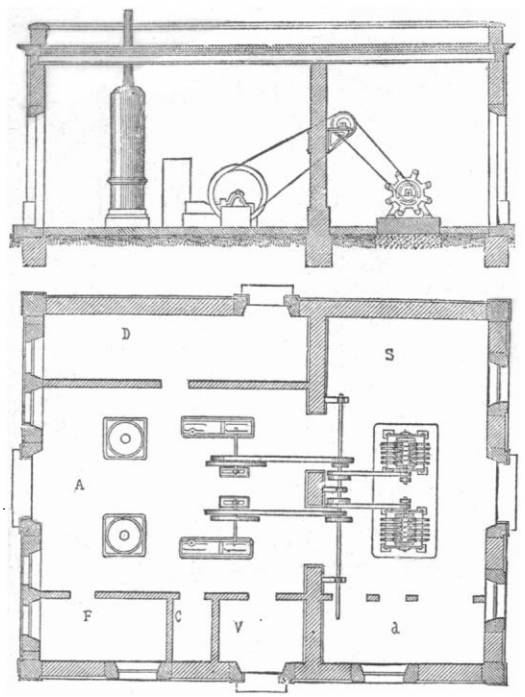


Fig. 7.

A. — Engine and boiler house. S. — Electric generator room. F. — Forge and heavy repair-shop. d. — Shop for light repairs. D. — Coal dépôt, with water-tank underneath. c. — Water-tank. V. — Vestibule.

arc from one story to the other. Since the establishment of the lights at la Hève, the latter means have been found superfluous, and will no longer be employed.

The light of Planier, which has just been finished, is about eight nautical miles from the port of Marseilles, upon a rock. It is a tower sixty metres high, and eighteen metres in diameter at the base, which rests on the rock itself.

Fig. 5 gives the details of the summit of the tower, and Fig. 6 those of the optical apparatus. In the latter figure are shown the fixed-light apparatus, and, movable around it, the drum, with vertical lenses. The mechanism for driving the latter is given in considerable detail.

In this apparatus the changing of the regulators is effected by means of a system of two pairs of rails; but they are not placed at an acute angle, as at la Hève. One enters direct

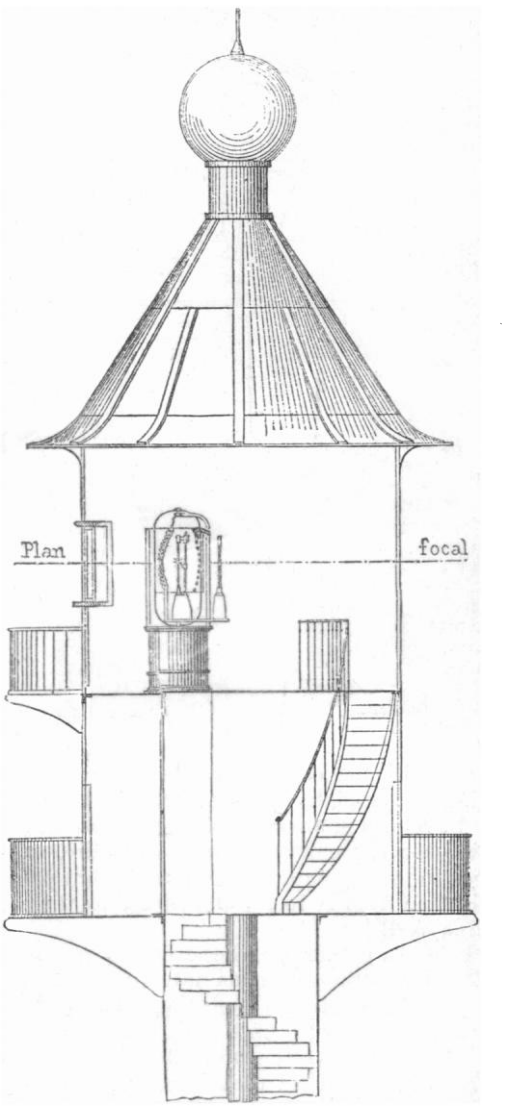


Fig. 8.

into the optical apparatus; the other is placed outside, and at right angles to the first. At their junction is a turn-table; and, with this arrangement, the manoeuvre of changing the lamps takes no longer than with oblique rails.

The de Meritens machines, which feed the regulator, are placed in a special building.

The plan and elevation of this building, which will serve as a type for those installed in most of the lighthouses, is shown in Fig. 7.

The Planier is a full horizon light. Its characteristic is that of three white flashes separated by a red flash. Its range, like that of all the new lights in the Mediterranean, is twenty-seven nautical miles for fourteen-fifteenths of the year.

We have mentioned that the transformation of the Palmyre light is also in progress. This, unlike the Planier, will throw a beam in one direction only; and the arrangement of the lantern is therefore slightly different. It is shown in Fig. 8. The general disposition resembles, up to a certain point, that of la Hève. The optical apparatus for the new fixed lights will have a diameter of 0.6 met., instead of 0.3, as was formerly employed. With the revolving cylinder of vertical lenses, this diameter will reach 0.7 met.

CRITICISM OF PROFESSOR HUBRECHT'S HYPOTHESIS OF DEVELOPMENT BY PRIMOGENITURE.

EVOLUTIONISTS have hitherto been puzzled to find a full and satisfactory explanation of the persistency of certain types, such as the familiar Lingula and others, through long periods of the earth's past. Prof. A. A. W. Hubrecht of Utrecht has offered, in his inaugural address, an hypothesis which he thinks adequate to solve this problem. The address is published in full in Nature, nos. 690–691. We may pass over the first part, which contains familiar matter only, and which, therefore, we venture to advise scientific readers to skip. The presentation of the author's own views begins near the bottom of the first column on p. 302. The habit of needless diffuseness in writing is a very grave encumbrance to scientific literature, and ought always to encounter the critic's emphatic condemnation.

The theory which Professor Hubrecht has advanced appears to us not only untenable, but unscientific; we think it might be characterized as pure speculation of that reckless quality which of late years has crept into zoölogy, considerably to the discredit of the science. To justify this condemnation, we will first state the author's hypothesis, and afterward the objections to it.

The hypothesis may be summarized as follows: 1. In many animals the period of reproduction is a prolonged one; so that there are young born of young parents, others of old parents, and, of course, of parents of intermediate age. A distinction therefore exists between first-born and last-born posterity. 2. Similarly, these first-born will likewise have first- and last-born; so, also, will the last-born; consequently there will be one set of generations of the first-born, and another set of the last-born. 3. In the first series the generations will follow rapidly, in the second series slowly, upon one another; hence, from a given pair, there will be in time numerous descendants; "a small number of these being descendants in a direct line of the first-born of every successive generation, another small number being the descendants in a direct line of the last-born of every successive generation." Consequently, of the contemporaneous generations, the individuals of the first set would have numerous ancestors; those of the second set, not nearly so many. 4. The age of the parent affects the character of the progeny. Of this, Hubrecht is able to bring forward only one example, — apparently the only one known to him; namely, that Stone found in the McCloud River that the eggs of young salmon are smaller than those of old salmon. 5. "I must now call your attention to the second cardinal point. . . . Heredity has, indeed, invested them [the progeny] with peculiarities, part of which show themselves in their organization; another part remaining latent, and only attaining development in following generations. Such a latent potential energy towards eventual modification of the individual or his progeny must needs find more occasions to unfold itself in the first-born, *simply because these are possessed of a larger number of ancestors*" (the italics are ours). 6. Asexual reproduction is accompanied by less variation than sexual.

From these premises, the deduction: that the first-born of sexual generations are the principal variants, and *ergo* the principal source of new species; and the last-born, *per contra*, the representatives of stability.

In rejoinder to this plausible but specious argument, our contention is, *first*, that we cannot assume that there are really any series of first- and last-born; *second*, that, granting the distinction between them, it cannot be assumed that one is more variable than the other; *third*, granting both these premises, the facts of zoölogy cannot be made to show that the permanence of types is derived from the last-born, nor that the evolution of new species depends on primogeniture to any considerable extent.

First, Any succession of first-born would depend upon both parents being first-born; and the probability of both parents so being for any considerable number of generations is so infinitely small that it might be called zero. Let us take a species which pairs (a bird, for example), and where the male fertilizes only one female. Let us assume that in a given locality there are ten of each sex, and of various ages, and that there is an equal chance of any two pairing; then the probability of the first-born male pairing with the first-born female would be 1 in 100. The chances of the next set pairing in the same manner would be also 1 in 100, if we further assume, what is the usual case, that the number of individuals remains constant. The chances of both pairs being first-born would be 100×100, or 10,000. In nine generations the chance of their being all first-born would become 1 in 1,000,000,000,000,000,000 (one million million million). Now, for birds which become mature in one year, these are the chances for nine years. Birds are known first from the Jurassic, which we will call for convenience 1,000,000 years ago; so that it might prove laborious to write out the chances for that period, the chance being the last term of a geometrical progression of which one million is the number of terms, and one hundred the ratio. Yet we have taken a case exaggeratedly in favor of Hubrecht's view. It were possible to adduce many arguments to show that the habits of animals often render the existence of a series of first-born improbable; but the previous calculation sufficiently disposes of Hubrecht's fundamental assumption. And, moreover, every such calculation would lead to essentially the same result, whatever the figures chosen to start with might be, because the chance is the last term of a geometrical progression. If Pro-

fessor Hubrecht finds mathematics unconvincing, we would beg him to consult genealogical records, by which he could ascertain the carefully registered contradiction of his assumption that there is a series of the first-born, or even an approximation to it.

Second, We cannot accept the assertion, that a large number of ancestors increases the tendency to variability, because the direct influence of the progenitors upon the production of variations very rapidly diminishes as the number of generations increases. And, on the other hand, it is well known that long-inherited characteristics are the most constant. The more ancient a feature is, the greater its fixity: hence we might as well assume the opposite of Hubrecht's assertion; viz., that the greater the number of ancestors, the more fixed the qualities of the young. Here it may be noticed, that although it is very probable that the parents' age causes modifications in the young, yet Hubrecht mentions only one fact to support the assertion, and that fact is the only one brought forward to support any portion of his hypotheses. We certainly have no sufficient reason for agreeing with the assumption that first-born would be more variable than last-born.

Third, If we admit the two previous premises, we should still have to show that they have given us the determination of the real causes. If evolution by primogeniture were a real cause, then the most variable animals, or those classes where there are most species, would, in consequence of inherited habit, produce young while themselves young, and the stable types would have acquired the characteristics of reproducing very late. Such, however, is not the case. Insects, the most variable of types, reproduce, for the most part, at the end of their lives; while the permanent type, Lingula, reproduces while young. Further objections might be added; but sufficient has been said to explain, and, it is believed, to justify, the condemnation of the hypotheses involved in the author's generalization.

Professor Hubrecht, by his able morphological researches on various subjects, notably on the anatomy of nemertines, has earned a well-deserved esteem: and it is a matter of regret to have to criticise any writing of his severely; but the tendency to draw a maximum of conclusion from a minimum of fact is one to which we feel impelled to object most strenuously. Hubrecht (p. 279) speaks almost sneeringly of what he is pleased to call the school of scientific zoölogists,[1] or those who have sought to elevate zoölogy above mere systematic work. The cause of his *animus* we do not know, but feel that he is hardly just, and not likely to wish to be called an *unscientific* zoölogist himself. Of his hypothesis of development by primogeniture, our opinion has been expressed.

CHARLES S. MINOT.

NOTES ON THE GEOLOGY OF JAPAN.

WE are permitted, by the courtesy of M. Jules Marcou of Cambridge, to make use of the following extract from a letter addressed to him from Tokio by Dr. C. Gottsche, professor of geology in the Tokio *daigaku*, or imperial university.

Since you published, seven years ago, the *Explication d'une carte géologique de la terre*, much has been changed in Japan. Lyman's flying surveys in Yesso and Japan expired in 1879. A new geological survey has been established, under the superintendence of Dr. E. Naumann; geology has been taught for more than six years, both in the university and at the engineering college of Tokio; and travellers are allowed to cross the interior in every direction. A mass of information has been procured in this way; and I suppose you will find valuable materials in the notices, and in the little sketch-map my friend and countryman, Dr. Naumann, is just preparing for you. Nevertheless, I take the liberty to furnish you with some additional remarks on facts or specimens which I have recently examined, and which might be overlooked by him.

The upper Devonian system is indicated by half a dozen specimens of Spirifer disjunctus de Verneuil, which I met in several old Japanese collections, and which partly originate from the provinces Tosa (on Shikoku) and Ise (on the main island). This fossil has not yet been met with *in situ*.

The carboniferous system is only represented by marine limestones, which are exposed in seventeen localities along the eastern coast of Japan, from 39° 10′ N. L. to 31° 20′ N. L. The fauna is very scanty; but everywhere the limestones are characterized by the common occurrence of Fusulina and Schwagerina, which in many cases are accompanied by Endothyra, Textilaria, and Trochammina. Among other fossils, I mention only Bellerophon (?) hiulcus Sow., Favosites, and Poteriocrinus.

The limestones correspond, in my judgment, to the whole carboniferous system, the upper productive series included. My reasons are: 1°. The different paleontological character of the lower carboniferous mountain-limestone of Lo-ping in China (cf. Kayser, *Zeitschr. deutsch. geol. gesellsch.*, 1881, 351); 2°. The common occurrence of the genus Schwagerina, which I think is confined to the uppermost carboniferous and lower dyassic systems of Nebraska, Russia, and Austrian Alps; 3°. The researches of V. von Möller, who states that the marine carboniferous limestones of Russia also represent the entire system. From the second point, it might seem that our Japanese deposits correspond only to the uppermost series, which in China is really productive.

The dark triassic shales, with Monotis salinaria, var. Richemondiana Zittel, which Dr. Naumann discovered near Sendai (*Jahrb. k.-k. reichsanst.*, 1881, 519), now extend from 40° N. L. (Niageba, province of Ugo) to 33° N. L. (Kinkaisan, province of Higo). This will be the more interesting to you as special care is devoted in your Explication to the Monotis strata. Very similar dark shales from Okatzumura and Minatomura, district of Ojikagori, province of Rikuzen (about 38° 30′ N. L., 141° 20′ E. long., Greenw.), are lower liassic. I recognized within them Arietites bisulcatus Brug., Arietites of rotiformis Sow., and Lytoceras sp. of the group of L. fimbriatum. The two Arietites are characteristic for the Ammonites Bucklandi-zone of Oppel.

The middle Jurassic is only represented by plant-bearing shales. Dr. Geyler of Frankfurt described already sixteen species from the Tetorigawa valley, in the province of Kaga (*Palaeontogr.*, xxiv. 221, 5 pl.), mostly identical with Jurassic species from Amuria, eastern Siberia, and Spitzberg. In the mean while the number of localities and fossils has somewhat increased. The said strata have been met with again at Nozirimura, province of Echizen; Ogamigo, district of Onogori, province of Hida; Midzutani, near Yuasa, province of Kishiu; and Tannomura, province of Awa, on Shikoku. The leading fossil is everywhere Podozamites lanceolatus

[1] Scientific zoölogy (*wissenschaftliche zoologie*) has had, since the establishment of Siebold and Kölliker's *Zeitschrift für wissenschaftliche zoologie*, a special significance to professional naturalists.

Lindl. sp., and P. Reinii Geyl. The fresh-water or brackish character of these deposits is proved by the occurrence of true and undoubted Cyrena sp. and Estheria.

The cretaceous fossils of Yesso are carefully examined by Naumann (*Mitth. deutsch. ostasiat. gesellsch.*, heft 21), and partly (thirteen species) identified with Indian types, partly with shells described by Schmidt, from Sachalin. His result is, that the Ammonite-beds of Yesso are upper-cretaceous, and correspond especially to the Ootatoor-group of India.

During the last vacation, I got, from Shikoku, sandstones which are also upper cretaceous. They are quite filled with a Trigonia of the scabra-group, probably T. aliformis Park. Two other Trigoniae, which I cannot determine with the literature at hand, fragments of Natica and Hamites, accompany it. The said sandstones have been met with at Oruno, district of Itanagori, province of Awa; Tannomura, district of Katsuragori, province of Awa; Yassudamura, district of Akigori, province of Tosa, — on the island of Shikoku.

The tertiary strata are rather thick. Those which have been studied by Dr. Brauns (*Mem. Tokio univ.*, no. 4, 1881) and A. Nathorst (*Svensk. akad. handl.*, 1882) are pliocene, most of the shells and plants described being identical with living ones. Miocene, or older strata, are not yet recognized with certainty.

Glacial phenomena have not left any traces in Japan.[1] I conclude here with the remark that the list of your *Explication* contains some volcanoes (nos. 8 and 9, p. 114; nos. 4 and 10, p. 115) which I cannot make out. More complete are the lists of Naumann (Yokohama, 1878) and Milne (*Trans. seismol. soc. Japan*, iv. 1882): but even these are not complete; for a recent revision I made gave forty-eight volcanoes which are active now, or have been active within historical time, or are still in the solfatara state. Besides that, I know about forty cones which are probably prior to human record, and date back as far as the pliocene series, which is very often tufaceous or filled with pumice-fragments.

PERFECT INTERFERENCE OF SOUND BY TELEPHONE.

SUPPOSE we have two telephones having the poles of their magnets similarly placed, and so connected with a circuit that a current will traverse their coils in the same direction. It is evident that any electric current passing will cause a simultaneous movement in the same direction in the diaphragms of both telephones. Now, if we conceive the current reversed in one of the telephones, the motions will have opposite signs. It follows, then, that the currents due to the vibration of the diaphragm of a third telephone in the circuit will produce in the two telephones vibrations of *opposite phases;* the sounds produced, therefore, will differ by a half-wave length. The same current which in one telephone produces a condensation will in the other produce a rarefaction.

The experiment, as successfully tried in the physical laboratory of Dartmouth college by Professor Emerson and myself, was arranged as follows: the mouths of two similar telephones were placed before the extremities of a Y-shaped tube, and the sound from both telephones conducted to the ear by rubber tubing. A reversing-switch was placed in the circuit, by means of which the direction of the current in one of the telephones could be changed; in this way could be produced at will coincidence or interference of sound. Each branch of the Y-tube was of rubber, so that either arm could be closed by pinching. Organ-pipes of various lengths were sounded near a telephone in a neighboring building. It was found, that, when arranged for interference, the pinching of either of the branch-pipes produced a very decided increase in the intensity of the sound; when reversed, an equally decided decrease. The inequality in the intensity of the sounds due to the two telephones was found to be the chief difficulty in producing complete interference; but by partly closing one branch, so as to weaken the stronger sound, the effect was much improved. In several trials the interference was complete, no sound whatever being audible. The rapid reversal by the switch gave a sharp contrast between the strengthening and the weakening effect.

This method of demonstrating the phenomenon of interference has obviously the advantage of applicability to sounds of any pitch. With singing, the interference was very satisfactory, especially with the lower notes; in conversation, however, the sound is not so much weakened, but the quality is perceptibly changed. The vowels seemed to suffer much more than the consonants. C. S. COOK.

[1] The writer ignores the discovery of Prof. J. Milne of the engineering school of Tokio, at the large mountain of Gwassan, northern part of Nipon, where are large bowlders and *roches moutonnées*, — the product of glacial action. — J. M.

RAILWAY-ACCIDENTS IN 1882.

THE statistics of railroad operation in this country are far too incomplete and unreliable to admit of drawing any very general conclusions. Certain facts, however, appear with sufficient distinctness to show some very grave defects in the system under which our roads are worked. The *Railroad gazette* publishes monthly and annually a list of accidents to trains while in motion. This, however, does not include over twelve per cent of the whole number of casualties. Again, accidents not resulting in loss of life or in serious damage to property are rarely recorded; though in many cases the blame is not less great, and the lesson conveyed not less important. The total number of train-accidents for the past ten years is returned as below; the second horizontal column showing the actual number, and the third column the number per thousand miles of road in operation: —

1873	1874	1875	1876	1877	1878	1879	1880	1881	1882
1,283	980	1,201	982	891	740	910	1,078	1,458	1,365
18.3	13.6	16.2	12.8	11.3	9.0	10.6	11.6	13.9	12.4

If we regard the second line alone, the figures would seem to be sufficiently discouraging, as there is a steady increase in the number of accidents from 1878 to 1881. We must, however, take into account the growth of the railroad-system. This is done in the third line; and here, again, while we find a somewhat less rate of increase, the fact still remains, that our roads are not growing safer as they expand in extent.

If we examine in detail the causes of accidents, we shall see that they are less dependent upon the total length of roads in operation, than upon the density of the traffic; in accordance with the law, that failures of track and bridges are approximately in proportion to the length of road, while the number of collisions is in proportion to the square of the number of trains.

Thus for the past ten years the number of collisions was as shown in the second line below, the number of derailments as in the third, and the number of broken bridges as in the fourth: —

1873	1874	1875	1876	1877	1878	1879	1880	1881	1882
392	260	278	279	268	220	310	437	536	581
815	655	840	655	581	481	557	597	857	742
19	33	26	20	21	21	17	16	44	38

While the length of railroads increased from 70,000 miles in 1873, to 110,000 miles in 1882, the whole number of accidents decreased steadily, from 1,283 in 1873, to 740 in 1878, and then increased to 1,365 in 1882; while the number of collisions ranged from 392 in 1873, to 220 in 1878, and then steadily increased to 581 in 1882. Moreover, this increase in collisions is shown very plainly to be due to the crowding of the tracks, as the butting collisions range from 102 in 1873, to 70 in 1878, and from that number to 160 in 1882; while the rear collisions run from 187 in 1873, to 142 in 1878, and from that number to 388 in 1882. Comparing the accidents month by month, we find two periods when disasters are most numerous; viz., the first quarter of the year, and the three months August, September, and October. The accidents during the first quarter are very largely due to the extreme cold of that season, — the total disasters from broken rails in the ten years above having averaged six times as many during the first quarter as in July, August, and September. Indeed, we can always detect the unusually cold winters by the number of broken rails. The disasters of August, September, and October are supposed to be due to the crowded state of the roads during the excursion-season, when a large number of irregular trains are run.

It is hard, from the imperfect records at our command, to draw such definite conclusions as would enable us to improve the condition of affairs upon our railroads; but the statistics recorded by the Gazette are of great value as far as they go, and will eventually furnish the data we need for increasing the safety of railway-travel. GEORGE L. VOSE.

LETTERS TO THE EDITOR.

A caterpillar-eating hen-hawk.

IN July, 1882, my nephew Malcolm Storer, being at Moosehead lake, had the curiosity to examine the stomach of a hawk which he had shot there, and was surprised to find that it contained a large number of caterpillars in all stages of decomposition through digestion. Though the examination was made soon after the bird was shot, none of the caterpillars were found alive; but ten or twelve of them were perfect, and fifteen or twenty could still be distinguished as caterpillars in the mass of more completely digested matter. It was evident, moreover, that the stomach contained no other kind of food. The caterpillars were of green color, with yellowish rings or blotches, and were as thick and almost as long as a man's little finger. The wings of the bird, having been brought to Cambridge, were found to be those of the broad-winged hawk (Buteo pennsylvanicus). In view of what is known of the food of hawks, it is not at all strange that they should regale themselves upon caterpillars when opportunity offers. The marsh-hawk (Circus hudsonius), for example, is said to be 'an indiscriminate feeder upon fish, snakes, and even worms;' and many other hawks are known to feed upon snakes occasionally, as well as upon lizards, in regions where they are to be had. The fact that both large hawks and small devour many insects, such as crickets and grasshoppers, has often been noticed.

F. H. STORER.

An Indian burial-mound.

At my request Mr. Frank La Flesche, an educated Omaha, made inquiries of the older men of his tribe about the burial of the famous Omaha chief Big Elk, who died about 1825. He writes me as follows: "In compliance with your request, I made inquiries about the mound made by the Omahas, in which Big Elk was buried; and was told that it was about as high as the shoulders of a tall man standing up, and that he was buried with great ceremonies. His favorite horse was strangled to death by his grave, and most of his horses and household goods were given to the poor. The place where he is buried is known by the Omahas as 'Big Elk's grave,' but by the whites as 'Black Bird hills,' as Black Bird was buried in the same place. It is said that Black Bird was buried with very little ceremony, as he died when the Omahas were being very much troubled with the small-pox; and he was *not* buried riding a live horse, as stated by some. A grandson of his is still living, and is about one hundred years old; and he thinks his grandfather died before he was born."

As we have very few reliable records of the erection of burial-mounds by Indians since the settlement of the country by the whites, the statements quoted above are of considerable importance; but these facts do not prove that all mounds are recent, or that all were made by the immediate ancestors of the Indian tribes which still erect mounds over their noted dead; any more than, for the same reason, they prove that the Omahas and other recent mound-building tribes are of the same stock with the ancient Greeks. The custom of raising a mound of earth or of stones over a grave is world-wide, and must not be taken for more than it is worth in archeology. There are so many kinds of mounds in this country, that it shows a limited experience in their investigation when a writer here and there asserts that they are all the work of the present Indians, or their immediate ancestors; and an equal disregard of known facts, when another as confidently asserts that they were all made by a people unlike and superior to the Indian race, and of great antiquity. Each earthwork, mound, and burial-place should be investigated and studied by itself. Side by side we may find earthworks entirely different in their character, and to be assigned to very diverse ages; so we may find burial-mounds of the same character near together, one of which may be so recent as to contain glass beads and other things obtained by the Indians from the whites, while the other may be of great antiquity. Their proximity will not in itself prove that they were made by the same people. Much careful and systematic work has yet to be done before the question so often asked, Who made the mounds? can be satisfactorily answered. By a proper study of the mounds and earthworks of North America, facts will at last be accumulated by which an approximate determination of their chronology and relation to existing peoples will be made possible. In this work the Peabody museum has been engaged for several years, and during the past season most important results have been secured. F. W. PUTNAM.

Cambridge, Mass., Feb. 19.

House-flies in the Philippines.

I remember, years ago, seeing a dried specimen of the house-fly sent to Boston in a letter as a great rarity there, — the only one the sender had seen in a year's residence in Manila. As this is one of the constant accompaniments of man, and a sure sign of his presence or vicinity, I was at a loss to account for its absence. It is not even found in the sugar-yards in any great numbers. I now see why it should be so rare; viz., because it could not of itself pass over the six hundred miles of the windy China sea; and the few which might be transported on vessels, if they got ashore from their distant anchorage, would be prevented from multiplying by their numerous enemies, — bats, spiders, birds, lizards, and other reptiles. Some days I would not see one, and rarely more than two, around the table. Were they common, with the other insect-pests, life would be almost unendurable in these islands. S. KNEELAND.

Solar corona.

Various reasons have been assigned for the very conflicting representations of the corona made by observers who have simultaneously sketched it. It seems to me that the principal cause of the very puzzling differences observed lies in the fact that the light of the corona falls so near the limit of visibility at the violet end of the spectrum as to excite the retina in different observers unequally.

I would have each observer tested for color-blindness in the part of the spectrum between G and H; and no doubt as great differences would be found in the sensitiveness of different eyes near the upper limits of visibility as is known to exist in different ears in perceiving sounds near the upper limit of audibility. Only those sketches of the corona could be properly compared with each other which were made by observers to whom the relative intensity of the various parts of the spectrum appeared approximately the same. H. T. EDDY.

Badly crystallized wrought iron.

An iron contractor told me, the other day, that he was called as an expert in a case where the wrought-iron strap of the walking-beam of a steamboat broke, and injured some one. The broken strap (about four by eight inches in section, I think) was shown, and the interior found to be very badly crystallized, — the worst case, my friend said, he ever saw. The exterior was of fair, ordinary texture. Afterwards, a part of the strap was cut off, sawn lengthwise into bars, and tested for tensile strength. All portions were rather weak, the highest resistance being but 36,000 pounds; but the inner sections, where the iron was worst crystallized, were the strongest of all.

Does any one know more about this case or any similar one? T. M. CLARK.

178 Devonshire Street, Boston, March 2.

WHITNEY'S CLIMATIC CHANGES.[1]

II.

IN the first part of this article the contents of the volume were described: the author's principal conclusions will now be discussed.

THE CAUSE OF THE GLACIAL EPOCH.

Professor Whitney's fundamental postulate, that the general temperature of the atmosphere is due to heat from the sun, is beyond controversy. His hypothesis that the intensity of solar radiation is gradually lessening, by reason of the dissipation of solar energy, and that the paleontologic record in arctic and temperate regions is in close sympathy with this lessening, will be admitted by most students. But when he asserts that the degradation of terrestrial climate has been continuous and uninterrupted, the glacial epoch notwithstanding, assent will not so readily be yielded. The idea that the glacial epoch was characterized by exceptional cold is all but universally entertained, and is so plausible on its face that it can be displaced only by cogent reasoning.

He advances two lines of argument, — first, that the phenomena of the glacial epoch were produced entirely by local causes, such as the elevation of mountains and the submergence of plains; second, that they belonged in the natural order of things to a warmer stage of the earth's climate, and have disappeared by reason of the secular degradation of climate. These two explanations are not clearly recognized as distinct, but are appealed to indiscriminately in the course of a somewhat desultory discussion; the one being more commonly called upon to account for the appearance of glaciers, and the other for their disappearance. If temporary local changes are competent to produce local glaciation, they would seem to be equally competent to terminate it; and a secular cause need not be appealed to. If, on the other hand, the glaciation of quaternary time has been actually abated by a secular change of temperature, it would seem logical to refer its inauguration also to a secular change.

The first line of argument is developed chiefly in a discussion of the distribution of glaciers, modern and ancient, with reference to local conditions. This is full of profitable suggestion; and it is hard to see how any one who has weighed the considerations therein adduced can entertain the hypothesis of a polar ice-cap. It appears beyond question, that the only work accomplished by the introduction of any conditions of a general nature favorable to glaciation would be the enlargement of existing glaciers, and the institution of limited ice-sheets in favorable localities. This, however, is a question of *a priori* possibilities: it is quite another matter to determine whether local conditions can be made to account for the ancient magnitude of glaciers. Whitney tells us that they can; but the only ancient ice-sheet he seriously undertakes to ex-

[1] Continued from No. 5.

plain in that way is the Scandinavian. So far as local conditions are concerned, he practically leaves the phenomena of England, Spain, Switzerland, India, New Zealand, and the Atlantic and Pacific coasts of North America, without a plausible suggestion. His analysis of the subject is, moreover, conspicuously incomplete in that it omits all but the most casual mention of ocean-currents. These great distributers of climate are in continual conflict with the elements dependent on latitude; and any remodelling of coast-lines or sea-bottoms which facilitates or impedes their circulation must influence the local distribution and local magnitude of glacial ice. While, therefore, his presentation of the subject is interesting and valuable, it is unsatisfactory. It suggests a line of inquiry of great promise, but it falls far short of a solution of the problem.

The idea that a general elevation of atmospheric temperature is more favorable to glaciation than a general lowering, is one which arises from an exaggerated appreciation of the importance of precipitation as a condition of glacier-formation. The existence of a glacier shows that the local precipitation in the form of snow exceeds the local ability of the processes of evaporation and melting to dissipate that snow in the course of the year: it shows an excess of solid precipitation over dissipation. All will admit, that, if the local temperature be lowered without a concomitant change in other conditions, the ice will increase; and *vice versa*. All will admit, too, that, if the local precipitation be increased without modification of the other conditions, the ice will be augmented; and *vice versa*. That is to say, the amount of the ice depends on local temperature and local precipitation. If the general temperature of the atmosphere be elevated by a change in solar radiation, the local effect is twofold: on one hand the local temperature is raised, and on the other the local precipitation is increased. The first change tends to diminish the volume of ice; the second, to increase it. Whitney's proposition is, that the latter tendency outweighs the former, and the glacier grows: the majority of investigators assume that the change of local temperature is the more important, and that the glacier shrinks. Considering the importance of this question to his discussion, and the all but universal prejudice against his view, it is surprising that he suffered the matter to rest with a mere declaration of opinion, without attempting a quantitative comparison. Let us endeavor to supply his omission.

There is no comprehensive knowledge of the climate of any point where glacial ice now actually accumulates; but we fortunately have an excellent meteorologic record of a station high in the Alps, where the conditions are presumably on the verge of glacier-formation, and where the climate cannot be far different from that of the surrounding ice-fields. Moreover, the observations at St. Bernard have been so thoroughly discussed by Plantamour, Wolf, and others, that the material is in the most available shape. Having for data a mathematically deduced annual curve of temperature, and an annual curve of precipitation, each based on the record for a long series of years, it is not difficult to introduce the hypothesis of a variation in general temperature, and obtain an approximate quantitative indication of the effect of this variation on glaciation. The mean temperature at St. Bernard is —1.76° (C.). Let us first assume that through a variation in solar radiation this temperature is raised 3°, and again that it is raised 6°; then that it is lowered 3°, and again 6°; and let us inquire what effect these variations will have upon the snowfall. Evidently there are two ways in which the snowfall is affected by a general rise of temperature: first, the fraction of the year during which precipitation takes the solid form is diminished, so that the snow forms a smaller percentage of the total precipitation; second, the change in temperature being general and not local, the power of the atmosphere to receive and transport moisture is increased, and the local precipitation is therefore increased. If we note the day in the spring when the curve of the annual oscillation of temperature passes upward through the freezing-point, and again the day in the fall when it passes the same point in descending, we have the limits of the portion of the year during which all the precipitation is theoretically fluid. (We are, of course, speaking of the ideal average year: in any individual year there is a time of transition, with more or less alternation of rain and snow.) Let us call this period 'summer,' and the remainder of the year, when precipitation takes the form of snow, 'winter.' Assuming that the form and amplitude of the temperature curve remain unchanged, while the mean temperature is varied as by hypothesis, we can readily ascertain the lengths of 'winter' and 'summer' for each of the assumed cases. These have been computed, and will be found in the subjoined table, lines IV. and XII. We next ascertain, by the aid of the precipitation curve, the amount of precipitation during each of these periods (V).

Computation of the relations of snowfall to melting and evaporation at St. Bernard, Switzerland.

I.	ASSUMED GENERAL RISE OF TEMPERATURE, IN CENTIGRADE DEGR.	−6	−3	0	+3	+6
II.	'Winter' begins	Aug. 17.6	Sept. 20.2	Oct. 11.1	Oct. 30.9	Nov. 23.8
III.	'Winter' ends	July 12.3	June 3.9	May 11.1	Apr. 19.9	Mar. 27.4
IV.	Length of 'winter' in days	327.7	255.7	211.0	170.0	123 6
V.	Precipitation during this period at the present time, in metres	1.1576	.9260	.7491	.5658	.3982
VI.	Mean temperature of 'winter'	−8.68	−7.74	−6.06	−4.14	−2.10
VII.	Corresponding mean temperature over Atlantic ocean, near France	+5.2	+7.9	+10.0	+12.0	+14.5
VIII.	Tension of saturation for temperatures VII. (millim.)	6.625	7.964	9.165	10.457	12.298
IX.	Tension of saturation for temperatures VI. (millim.)	2.322	2.512	2.876	3.351	3.925
X.	Ratios of precipitation (VIII. — IX.)	4.303	5.452	6.289	7.106	8.373
XI.	Relative snowfall (V. × X. × .2122)	1.057	1.071	1.000	.853	.708
XII.	Length of 'summer' in days	37.3	109.3	154.0	195.0	241.4
XIII.	Mean temperature of 'summer'	+0.26	+2.22	+4.13	+5.93	+7.48
XIV.	Relative melting-power (XII. × XIII. × .001572)	.015	.381	1.000	1.818	2.839
XV.	Mean annual temperature	−7.76	−4.76	−1.76	+1.24	+4.24
XVI.	Corresponding tension of saturation, in mm. of barometric pressure	2.506	3.191	4.028	5.025	6.200
XVII.	Comparative rate of evaporation (XVI. ÷ 4.028)	.622	.792	1.000	1.247	1.539
XVIII.	Comparative rate of dissipation ($\frac{1}{3}$ XIV. + $\frac{2}{3}$ XVII.)	.420	.655	1.000	1.437	1.974
XIX.	Ratio of snowfall to snow dissipation (XI ÷ XVIII.)	2.518	1.635	1.000	.593	.359

The air-currents which cross the Alps, and from which the precipitation at St. Bernard is derived, acquire their moisture chiefly from the Atlantic ocean. The temperature over the Atlantic being higher than on the Alps, the air is there able to receive a larger portion of moisture than it can retain in the Alps; and in a general way the precipitation on the Alps may be said to be due to this cause. It is true that the air-currents traversing the Atlantic do not become perfectly saturated, and that on the way to the Alps they sometimes increase their aqueous contents by absorption from the Mediterranean or from the land, and sometimes diminish it by precipitation; but the only measure of Alpine precipitation available for the present purpose is obtained by deducting the co-efficient of saturation corresponding to the temperature on the Alps from the co-efficient of saturation corresponding to the temperature over the Atlantic. By ascertaining this difference for the existing temperatures, and again for the temperatures assumed in the hypothetic cases, we are able to make a comparison between the actual rate of precipitation and that which would obtain if the general temperature of the atmosphere were raised or lowered. The annual procession of temperature over the Atlantic ocean is not accurately known; but the tract of most importance for the present purpose is that partially surrounded by England, France, and Spain: and its temperature conditions are sufficiently well determined by the observations in these countries. By the aid of the isotherms plotted for each month by the French bureau of meteorology, the temperature of a definite portion of this region has been deduced for each month of the year. Line VI. of the table gives the mean temperature of 'winter' at St. Bernard for each of the five cases. Line VII. gives the mean temperature over the indicated portion of the Atlantic for the same periods and on the same assumptions. In lines VIII. and IX. the maximum tension of aqueous vapor in the atmosphere, expressed in millimetres of barometric pressure, is given for each of these temperatures; and the differences between these (X.) are taken as measures of the relative rates of precipitation under the various assumptions. Multiplying these rates by the corresponding numbers of line V., we obtain a series of numbers which measure the relative snowfall under the several assumptions. (For convenience these numbers have been multiplied by an arbitrary constant, so as to express them in terms of the present precipitation as unity.) For example: in the assumed case of a general temperature 6° lower than the present, the length of 'winter' is 327.7 days. At the present time the total precipitation in rain and snow during that period is 1.1576 metres; and in the assumed case the whole of this precipitation would be in the form of snow. This is notably greater than the present snowfall, .7491 metres: but the general rate of precipitation, affecting the whole year alike, would be less than the present in the ratio of 4.303 to 6.289; and these two factors, tending in opposite directions, so nearly neutralize each other that the total snowfall (XI.) in the assumed case differs by only 6 per cent from the actual.

The figures of line XI. show, for a thermometric range of 12° (C.), a variation of only 35 per cent in the snowfall, and indicate, that,

if the formation of glaciers depended exclusively on precipitation, it would not be greatly influenced by a general change of temperature. The actual influence is exerted chiefly through the agencies of dissipation; to the consideration of which we now pass.

The dissipation of the snow is accomplished partly by evaporation and partly by melting. Whether one process or the other preponderates, depends upon circumstances; and in the case under consideration we do not know their relative importance. We have therefore made separate computation of the ratios of melting and evaporation. Melting takes place only during the period we have designated 'summer'; and its rate during that period is measured by the mean temperature, expressed in centigrade degrees. If, therefore, we multiply the length of the 'summer' in each case by its mean temperature, we obtain a number indicative of its relative power to melt snow and ice. These numbers are given in line XIV., and exhibit a wide range; the rate of melting with a general temperature 6° higher than the present being nearly three times as great as the present, and the rate with a general temperature 6° lower than the present being less than the sixtieth part of the present rate.

Evaporation is not restricted, like melting, to the 'summer' period, but goes on during the entire year whenever the atmosphere is not saturated with vapor. Strictly speaking, its rate is measured by the difference between the amount of moisture actually in the air and the amount necessary to produce saturation. We have no direct means of ascertaining this rate for our assumed cases; but it seems reasonable to suppose that the relative humidity, or the ratio of mean actual vapor-tension to the tension due to saturation, would be the same in all the cases; and upon this postulate the rate of evaporation for each case is measured by the tension of saturation due to the mean annual temperature. These tensions are given in line XVI., and the deduced rates of evaporation in line XVII. These numbers do not increase so rapidly as those expressing the melting-power; but they indicate that the rate of dissipation by evaporation is doubled by a general rise in temperature of 9°.

Since, then, a rise of general temperature diminishes slightly the solid precipitation, and at the same time increases greatly both the rate of melting and the rate of evaporation, it is evident that it is not favorable to the formation of glaciers; and we shall obtain the same qualitative result, whatever we assume to be the relative importance of melting and evaporation. For the sake of reaching a definite quantitative result, we will make the arbitrary assumption that the snow now precipitated at St. Bernard loses two-thirds of its volume by evaporation and only one-third by melting. This gives for the ratios of dissipation the numbers contained in line XVIII. Dividing the relative snowfall (XI.) by the relative dissipation (XVIII.), we obtain the ratio of snowfall to snow-dissipation (XIX.) which may be taken to express the tendency to the formation of glaciers. This tendency appears to be increased two and one-half times by 6° lowering of general temperature, and diminished nearly two-thirds by a corresponding advance of temperature. Considering the entire range of temperature indicated by the hypotheses, each increment of $4\frac{1}{2}°$ doubles the conjoint power of evaporation and melting to remove the precipitated snow.

It is, of course, not imagined that this analysis takes account of all the climatic factors affecting the problem; but it is believed that no omitted factor can modify the qualitative result. One of the most important of the ignored considerations is that of the influence of rain upon the rate of melting. There is no way in which the heat of a warm current of air is communicated so rapidly to a bed of snow or ice as by means of the precipitation of rain; and, since rainfall is necessarily increased by rise of temperature, our results would be somewhat strengthened if this factor were taken into account.

Another factor of possible importance is connected with the velocity of air-currents. The circulation of the atmosphere is caused by differences of temperature, and these differences arise from solar heating; so that an augmentation of solar heat tends to accelerate the aërial currents. This acceleration would probably not be great for the range of temperatures here considered; nevertheless, it would be worthy of consideration if we were able to give a quantitative expression to its effects. One of these effects would be an increase of precipitation, including an increase of snowfall; another would be an increase of the rate of melting; and a third would be an increase in the rate of evaporation. In their relation to our results, these effects might perhaps neutralize one another.

The problem we have thus examined is by no means simple, and it is not impossible that some meteorologic fallacy lurks behind our figures; but, until it shall be pointed out, we are constrained to believe that one of Pro-

fessor Whitney's chief postulates is untenable.

Another postulate, and the one most essential to his general theory, is equally at variance with the ordinary belief of men, and is, in our opinion, equally erroneous. It will be considered in the third and final part of this article.

AMERICAN PALEOZOIC FOSSILS.

MILLER, S. A. *The American paleozoic fossils: a catalogue of the genera and species* (etc). Cincinnati, *the author*, 1877, 1883. 16+334 p. 8°.

THIS second edition of Miller's catalogue of American paleozoic fossils consists of the original list issued in 1877, with a consecutively paged supplement of some ninety pages. The work is essentially a catalogue of genera and species, with names of authors, dates, places of publication, groups of rocks in which the species are found, and the etymology and signification of the names applied to them. There is also an introduction to the stratigraphical geology of the paleozoic rocks, a chapter on the construction and application of names in paleontology (contributed by Prof. E. W. Claypole), and an explanatory preface to the original, and to the supplementary part. It is needless to dilate on the usefulness of a work of this kind, which commends itself at once to the notice of working naturalists, even those not especially devoted to paleontological studies. Catalogues and bibliographies, even when of inferior execution, are always welcome to the student as labor-saving tools, and when well done are invaluable. The testimony of experts in this case is to the effect that the work has been done with care and completeness; though, as in all such catalogues, it would be strange if there were not some omissions. In the way of criticism, we should say that the addition of the number of the page to that of the volume, or to its abbreviated title, would have been little additional labor to the industrious compiler, and would save much time to the person using the work as a means of reference, especially to old works which are often destitute of an index. Furthermore, except in the case of confessedly absolute synonyms, we believe it is better to express the compiler's view, that a certain generic or specific name is merely the equivalent of another, by a mark of interrogation preceding the sign of equality and the supposed prior name. In this way there is less liability to error in matters about which authors are not universally agreed, than when a positive statement is made on one or the other side. It would also be well if a bibliography of the works cited in the list, often by titles so condensed as to be difficult of recognition by those unfamiliar with paleontological literature, were to be added to the volume. These, however, are suggestions rather than criticisms; and we may supplement them by further suggesting that naturalists would be under still greater obligations to Mr. Miller, should his time and inclinations lead him to prepare similar catalogues for the later geological formations.

AUSTRALIAN CRUSTACEA.

Catalogue of the Australian stalk and sessile-eyed Crustacea. By WILLIAM A. HASWELL. Sydney, 1882. 24+324 p., 3 pl. 8°.

THE Australian museum has recently issued a list of Australian crustacea, much after the pattern of the list of New-Zealand crustacea, published six years ago. The present work is largely a compilation; the author for some reason usually preferring to copy the descriptions of authors, even when specimens were at hand, while the synonymy exhibits many proofs of a like treatment. There occur to us several species which should have been inserted in the list, but which appear to have escaped Mr. Haswell: these are, —

Paramicippa affinis Miers.
Halimus auritus Edwards. —(Pt. Philip, Kinahan, *Proc. roy. Dublin soc.*, i. 117, 1858.)
Lambrus latirostris Miers.
Leitocheira bispinosa Kinahan.
Pilumnopeus crassimanus A. Milne-Edwards.
Pilumnus deflexus A. Milne-Edwards.
Neptunus rugosus A. Milne-Edwards.
Thelphusa angustifrons A. Milne-Edwards.
Thelphusa crassa A. Milne-Edwards.
Gelasimus longidigitum Kingsley.
Gelasimus annulipes Edwards.
Ocypoda fabricii Edwards.
Ocypoda convexus Quoy et Gaimard.
Pachygrapsus transversus Gibbes (P. levimanus Stimps.).
Heterograpsus crenulatus Edwards.
Cyclograpsus tasmanicus Jacquinot et Lucas.
Macrophthalmus dilitatus Edwards.
Macrophthalmus definitus White.
Calcinus latens.
Alpheus bidens Edwards.
(Alpheus thetis White is merely mentioned, but not in such a manner as to imply that it belonged to the Australian fauna, as in reality it does.)

Still, leaving these deficiencies, the work will probably have a certain value for the students of Australia, as it brings together in a compact form descriptions of a large proportion of the crustacea of the antipodean continent.

J. S. KINGSLEY.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

GEODESY.

The lake survey. — There has just been issued by the chief of engineers, in a quarto of 920 pp. with thirty plates, a detailed report of the operations in the prosecution of the survey of the Great Lakes. This important work is now finished, and the report presents in a comprehensive manner the methods used and results obtained. While omitting the vast amount of uninteresting detail with which such works are usually encumbered, all important features are given mention; and the whole volume is indexed with such care that any particular subject may be instantly found. The report starts with a historical account of the survey, from its inception in 1841, to its completion; gives a synopsis of the work accomplished under the various officers who from time to time have had charge of the survey; gives an account of the standards of length upon which the surveys depend, of the measuring-bars used and methods of using them, and of the results obtained both in the measurement of the base lines and in the results of their connection by triangulation, and of the geodetic and astronomical work. The part devoted to the discussion of the base apparatus will be found of special interest to geodeticians. Full account is given of the determination of the constants of the apparatus used, and of the co-efficients of expansion. Also there is a discussion of the 'set' of a zinc bar when heated. A portion of the book is devoted to the consideration of the mean levels of the Great Lakes, and the methods by which the results were obtained. The question of tides in the lakes had been previously considered (*Report of chief of engineers, 1872*). The tides are perceptible, but of scientific rather than practical importance, the maximum being less than two inches. — (*Professional papers, corps of engineers*, no. 24.) H. W. B. [346

MATHEMATICS.

Elliptic-function formulas. — Integral forms are given for certain products and quotients of the elliptic functions en$n$, en$n$, and dn$n$. The author, Mr. Craig, starts out from a formula of Mr. Glaisher's for the second derivative of the function cn$^n u$. — (*Amer. journ. math.*, v., 1882.) T. C. [347

Intersections of circles and spheres. — Gen. Alvord gives geometrical solutions of the problems, — to draw a circle cutting three given circles at the same given angle, to draw a circle cutting four given circles at the same unknown angle, and the analogous problems for spheres. — (*Amer. journ. math.*, v. 1882.) T. C. [348

Symmetric functions. — Mr. Durfee has given tabulated values of the functions (of weight twelve) of the co-efficients of the twelfthic in terms of the symmetric functions of its roots, also the values of these symmetric functions in terms of the co-efficients. — (*Amer. journ. math.*, v. 1882.) T. C. [349

Elliptic functions. — This is the first part of a paper by Otto Rausenberger, in which he introduces a new idea into the theory of elliptic functions. Instead of, as usual, considering doubly periodic elliptic functions, he considers that an advantage is gained by considering what may be called transcendants, with simply multiplicate periods (*einfacher multiplicatorischer periode*); that is, functions satisfying the equation $f(px) = f(x)$. The notation which he has adopted is made to conform as nearly as possible with that employed by Königsberger in his '*Vorlesungen über die theorie der elliptischen functionen.*' He defines certain functions, $\eta_0, \eta_1, \eta_2, \eta_3$, which are analogous to the ordinary theta-functions, and gives the values of functions S (p, x), C (p, x), D (p, x), which correspond in the ordinary notation to sn x, cn x, dn x, in terms of these η-functions. The equations are identical in form with those giving sn x, etc., in terms of the θ-functions. In conclusion a discussion of some of the properties of multiplicate periodic functions is given. — (*Journ. reine angew. math.*, xciii.) T. C. [350

Binary quintics. — An extensive discussion of the Hessian of the binary quintic is given by Mr. F. Lindemann. The expressions for the invariants and quadratic covariants of this sextic covariant, in terms of the invariants and covariants of the quintic to which it belongs, are obtained, and a relation found to exist between them, which is the necessary and sufficient condition that a given sextic may be the Hessian of a quintic. The typical expression of the Hessian by means of its quadratic covariants is next found. In the course of obtaining this, it is observed, that, when a certain invariantive condition is fulfilled, the quintic is reducible to a known soluble form. The remainder of the article contains the investigation of the peculiarities which attach to the Hessian on the supposition of any peculiarity in the quintic, and *vice versâ*; the determination of a quintic whose Hessian is given; and, finally, a geometrical interpretation of the condition satisfied by any sextic which is the Hessian of a quintic. — (*Math. ann.*, xxi. 1, 1883.) F. F. [351

Theory of numbers. — In an article on power-residues (*potenzreste*) F. Hofmann employs the device of representing the residues of the successive powers of a number with respect to a prime-number modulus as the successive vertices of a regular polygon inscribed in a circle, to prove Gauss's theorems concerning the sums of the primitive roots of the binomial congruence, $x^{p-1} \equiv 1 \pmod{p}$. He makes some remarks on binomial equations, and their connection with binomial congruences. — (*Math. ann.*, xx. 4, 1882.) F. F. [352

PHYSICS.

Acoustics.

Range of sounds in air. — Allard has deduced a formula for the intensity of a sound in terms of the work done in producing it (T), the rate of vibration (n), and the extreme range (x). The table given by him shows that the intensity of the sound in air decreases more rapidly than is indicated by the law of inverse squares. At the extreme range, all the sounds are reduced to the same intensity; while the values of $\frac{T}{x^2}$ vary, for the six instruments used, from 0.10 to 13.46.

A cause of this enfeeblement of sound is the reflecting action of the successive layers of air of different density when the atmosphere is not homogeneous. A formula is deduced which takes this action into account, which, with its constants determined from the experiments described, gives for a moderate acoustic transparency of the air, —

$$T\,(0.473)^x = 0.0000277\, n\, x^2.$$

The work necessary to cause a given increase of range, and the range of sounds of different pitch produced by the same expenditure of energy, can also be determined from the formula. The difference of

range for the extent of an octave is slight. — (*Comptes rendus*, Nov. 22, 1882.) C. R. C. [353

Heat.

Relation between latent heat, specific heat, and volume. — It is pointed out by Mr. Trouton that the latent heat of gasification at constant pressure of any body, divided by the product of the relative volume of the gas and the specific heat of the body, is approximately constant. This constant is calculated for many substances. The only marked exceptions are water and acetic acid. — (*Nature*, xxvii., No. 691.) C. B. P. [354

Exception to the second law of thermodynamics. — An ingenious method has been devised by Prof. H. T. Eddy to show that radiant heat is an exception to the second law of thermodynamics. The method is based upon the fact that heat is radiated, not instantaneously, but with a finite velocity, and consequently it is possible for occurrences to take place, during the exchange of radiations between two bodies, such as essentially to alter the ultimate distribution of heat. If three screens, composed of some perfectly reflecting material, are provided with suitable apertures, and are placed parallel between two radiating bodies, velocities can be communicated to the screens such that radiations from the first body will pass through the apertures to the second body, while the radiations from the second body will be intercepted, and reflected back. Thus, if the temperature of the first body is less than that of the second, heat can be transmitted from a colder to a hotter body without compensation, and without the expenditure of work.

The axiom of Clausius, that heat cannot of itself pass from a colder to a hotter body, and the similar axiom of Thomson, are thus only true with regard to radiations, if the velocity of radiation is infinite.

The arrangement employed by Prof. Eddy, which he calls the 'radiation siren,' proves that we can no longer regard the law of dissipation of energy of universal validity, and we cannot accept the principle of Clausius, that the entropy of the universe tends to a maximum. — (*Proc. Amer. phil. soc.*, xx. No. 112.) C. B. P. [355

Electricity.

Electric railways.—Professor Ayrton, in a lecture at the Royal institution, showed that the weight of a train on an electric railway would be comparatively small, because stationary engines would be used, and each pair of wheels on all the cars could be used as drivers. Hitherto the objection to the extension of electric railways has been, that the insulation of the rails used as part of the motive circuit was imperfect. Prof. Perry and the lecturer have devised an arrangement by which the passing train depresses a series of corrugated steel disks mounted on stands some inches above the track, and thus makes a carefully protected contact with the insulated main cables on each side; at the same time putting a temporary earth fault in an auxiliary wire, which records at the station the progress of the train. The track is divided into sections, from each of which the current is cut out while a train is on the section next in advance. If a train enters the section so cut out, its electromotors are shunted, so as to powerfully resist the motion of the train. The electric lighting of the cars is kept up, in such a contingency, by the automatic switching-in of Faure batteries. — (*Nature*, Jan. 11.) J. T. [356

Wimshurst's electrical machine. — Two circular glass plates 14½ inches in diameter, and ⅛ of an inch apart, with 12 brass strips cemented on the outside of each at equal angular intervals, rotate in opposite directions on the same axis. Opposite strips on the same plate are connected once in each revolution by a curved metallic rod terminated with brushes. The electricity is collected by combs opposite the horizontal diameter. With the instrument described, under ordinary atmospheric conditions, a 4½-inch spark was obtained once in every 2½ revolutions. The only apparent exciting cause is the friction of the air between the plates. — (*Engineering*, Jan. 5.) J. T. [357

New telephone receiver. — S. P. Thompson has devised an improvement on the instrument of Philip Reis, who utilized the sound emitted by a magnetized bar due to fluctuations in the magnetizing circuit. The improvement consists in making the magnetized core slender and subject to adjustable tension, and attaching one end to a suitable vibrating plate. In one form two cores are used, one being of nickel, which contracts when magnetized; the opposite movements being used to increase the distortion of the membrane. It is claimed that articulation, especially of sibilants and certain other consonants, is more distinct with this than with the common receiver. — (*Engineering*, Jan. 26.) J. T. [358

Value of the Siemens unit. — E. Dorn, by a modification of Weber's second method by which he eliminates the influence of terrestrial magnetism, establishes the relation

$$S \cdot U = .94825 \times 10^{10} \frac{\text{mm.}}{\text{sec.}},$$

and compares this result with those of other observers in this table: —

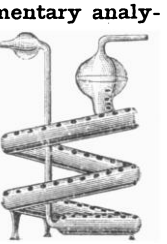
Lorentz	.9333	[1]Brit. Assoc. . .	.9530
Rayleigh	.9413	[1]Rowland { from .	.9431
Kohlrausch . . .	.9440	{ to . .	.9459
H. F. Weber . .	.9550	Dorn	.9483

(*Ann. phys. und chem.*, xvii. 13.) J. T. [359

CHEMISTRY.

(*Analytical.*)

Absorption apparatus for elementary analysis. — For absorption of the products in organic analysis, C. Winkler proposes the spiral apparatus shown in the accompanying illustration. It should be capable of holding 20 grms. of sulphuric acid or 15 grms. of potassium hydrate solution; and it may be used to absorb either water or carbonic dioxide. — (*Zeitschr. anal. chem.*, 1882, 545.) C. F. M. [360



Separation of barium from strontium or calcium by potassium chromate. — J. Merscherzerski finds that barium chromate is soluble in 23,000 parts water, more soluble in acetic acid, and it has a great tendency to carry down other salts from the solution in which it is precipitated. Since strontium chromate requires 840 parts water for solution, it would be precipitated in a solution containing more than one per cent. The author therefore concludes that this method affords a convenient and sufficiently accurate means for a qualitative separation; but it cannot be relied upon for quantitative purposes. — (*Zeitschr. anal. chem.*, 1882, 399.) C. F. M. [361

[1] These results depend on the ratio, given by Kohlrausch, $\frac{\text{B . A . unit}}{\text{S . unit}} = 1.0493$.

Testing for barium or sulphuric acid. — The minimum strength of a solution of barium chloride in which barium can be detected with certainty, according to S. Pickering, is 1 part barium in 833,000 parts water; and the re-action is equally delicate with sulphuric acid or ammonium sulphate. The precipitation was observed against a black background by means of an artificial light placed almost vertically above the test-tube. — (*Chem. news*, xlvi. 223.) C. F. M. [362

Estimation of sulphur in iron and steel. — G. Craig meets with good results by passing the gases evolved with hydrochloric acid through an ammoniacal solution of hydrogen peroxide. — (*Chem. news*, xlvi. 199.) C. F. M. [363

Detection and estimation of titanium. — A. Weller finds that the change in color produced when titanic acid is formed by oxidation of the sulphate with hydrogen peroxide is sufficiently delicate to render the re-action a suitable means for the determination of titanium. — (*Berichte deutsch. chem. gesellsch.*, xv. 2592.) C. F. M. [364

Estimation of titanic acid in presence of iron. — A method proposed by Pasani for the volumetric analysis of a solution containing titanic acid and iron depended upon his observation that the acid oxide of titanium (TiO_2), when reduced to the sesquioxide (Ti_2O_3) by nascent hydrogen, could be completely oxidized by potassium permanganate, even in presence of iron in the ferrous condition. According to E. Wiegand, this method is incapable of giving constant results. He finds that ferrous oxide undergoes partial oxidation before oxidation of the titanic sesquioxide is complete, and therefore infers that ferric oxide and titanium sesquioxide can exist in the same solution. — (*Zeitschr. fur anal. chem.*, 1882, 510.) C. F. M. [365

Volumetric analysis of peroxides. — A comparison of Bunsen's and Mohr's methods for the determination of available oxygen in peroxides by W. Diehl shows that digestion with hydrochloric acid and potassium iodide, recommended by Mohr, gives as exact results as the distillation in Bunsen's method. Digestion with acetic instead of hydrochloric acid affects as complete decomposition of manganese dioxide, either freshly prepared or in pyrolusite; and at the same time potassium iodide is without action upon ferric acetate. The available oxygen and the percentage of iron in manganese dioxide may therefore be ascertained by two determinations, in one of which hydrochloric acid is used, and in the other acetic acid. In lead peroxide the available oxygen may be as accurately determined by digestion with acetic acid and potassium iodide as by Bunsen's method. — (*Dingler's polytechn. journ.*, 246, 196.) C. F. M. [366

METALLURGY.

The Siemens direct process. — This consists in heating mixed fine iron-ore and coal in a horizontal, slowly revolving cylinder. The iron forms a sponge ready for rolling, while the silica and earthy impurities form a slag, which removes the hurtful sulphur and phosphorus from the iron. Mr. James Davis of Landore, Wales, gives his experience. He makes one ton of wrought iron with one ton of gas-producer coal, reduces the sulphur to a trace, and the phosphorus to .05 per cent. He finds magnesia bricks to stand the best. In 32 days 21 hours net working time, with 200 heats, using 200 tons of ore and 120 tons hammer scale, he made 217 tons 5 cwt. of blooms. — (*Eng. and min. journ.*, Jan. 6, 1883.) R. H. R. [367

Recovery of precious metals from slags. — A patent has been obtained by Mr. Richard Pearce of Denver, on an improvement in smelting gold and silver ores. The process consists in throwing upon the slags, as soon as the charge is perfectly melted, a fine-powdered oxide of copper or roasted copper matte. The furnace is then closed a short time. A reaction takes place, and a matte descends, thereby robbing the slag of its precious metals. For a charge of 3 tons of ore, 30 lbs. of oxide of copper are needed. — (*Min. and sc. press*, Dec. 16, 1882.) R. H. R. [368

Basic open-hearth steel process. — Mr. O. T. Tellander has described the adaptation of this process at the Alexandrowsky steel-works, St. Petersburg, Russia. The steel is made from pig-iron, scrap-iron, spiegel, and ferro-manganese, which are melted in the usual Siemens-Martin furnace. The special feature of the basic process consists in lining the furnace with bricks made of dolomite mixed with 18 per cent of coal-tar. The joint between this lining and the outer Dinas bricks is made by a layer of chrome-iron-ore and coal-tar. A mixture containing .5 per cent of phosphorus yields steel with an average of only .04 per cent. The sulphur is also reduced as much, while the silicon is almost entirely removed. — (*Eng. and min. journ.*, Jan. 13, 1883.) R. H. R. [369

AGRICULTURE.

Value of sprouted and dried seeds. — Experiments by Will led to the following conclusions: —

1. Mature seeds of common cultivated plants suffer no diminution of the proportion of seeds capable of sprouting, if soaked twelve hours in water, and then dried at ordinary temperatures. Some samples of peas constituted exceptions to this rule. Soaking twenty-four hours, and then drying, usually caused a slight decrease in the percentage of seed which germinated.

2. Some seeds even survive an interruption of germination in its first stages. The radicle dies, but is replaced by adventitious roots. The plumule is more enduring: even when the terminal bud is destroyed, lateral buds may develop.

3. The proportion of seeds capable of regermination is, in general, inversely proportional to the extent to which germination has progressed.

4. The extent to which the first germination may be carried varies in different kinds of seeds. Monocotyledonous seeds seem, in general, to withstand this treatment better than di-cotyledonous.

5. In view of the fact that such seeds germinate only under the most favorable conditions, the use of seed that has once been germinated is not to be recommended in practice. — (*Landw. versuchs-stat.*, xxviii. 51.) H. P. A. [370

Prevention of potato-disease. — According to Jensen, this disease, which is caused by a fungus (Peronospora infestans, Tul.), attacks first the tops, and is conveyed to the tubers by means of spores washed into the soil by rain. He therefore proposes to prevent this by running a plough between the rows, so as to throw up a furrow upon the top of the hills, while at the same time the tops are bent over so as to hang above the neighboring furrow. This should be done at least as soon as the disease shows itself on the tops; usually by the middle of August. In this way the washing of the spores into the hill is prevented. Furthermore, the potatoes should not be dug for at least two or three weeks after the tops are entirely wilted, to avoid infection from the latter. Field experiments with this method gave very favora-

ble results. — (*Biedermann's centr.-blatt.*, 1882, 755.) H. P. A. [371

GEOLOGY.

Impressions on Potsdam sandstone. — At the meeting of the Natural history society of Montreal, Feb. 26, Mr. Walter Ferrier exhibited specimens of some new trails and impressions of animals from the Potsdam of Rainbow Falls, near Au Sable chasm on Lake Champlain. One of them is a cast of two narrow furrows about a quarter of an inch apart, with a rim of punctiform impressions about an inch distant at either side. This impression is repeated in two places on a ripple-marked slab. It may be the track of a trilobite with two prominent spines on the pygidium, possibly of some species of Dikellocephalus. Another is a trail about an inch in width, marked with transverse furrows and ridges, perfectly simple, and without any median ridge. In this last respect they differ from the trails known as Rurichnites, Cruziana, Arthrichnites (Arthrophycus), and Traena. They resemble, though on a larger scale, impressions from the Erian sandstone of Gaspé, of which a slab from the collection of Dr. Dawson was exhibited for comparison. Such impressions, destitute of a central ridge, may have been made by gasteropods or by worms without any abdominal furrow. The name Clydichnites (wave-tracks) has been proposed for them by Dr. Dawson; and the Potsdam and Erian forms must belong to two distinct species. — J. W. D. [372

Newfoundland geology. — The report of progress of the Geological survey of Newfoundland for the year 1881 contains a report of Mr. J. P. Howley on the structure of the peninsula of Avalon. He finds that the major part of the peninsula is made up of the various divisions of the Huronian or Intermediate system, as given in the report for 1868, resting upon a nucleus of gneiss, and succeeded by the fossiliferous beds of the primordial Silurian or Taconic, which skirt the shores of the bays, and form most of the islands therein. In division *d* of the Huronian system the fossils Aspidella terranovica and Arenicolites spiralis occur. He recognizes two large intrusive masses of plutonic rocks, — one in the eastern, and the other in the western peninsula. That in the eastern peninsula he considers the older, as it has not affected the primordial strata, as has been the case in the western peninsula. The eruptive mass between Salmon cove and Collier's bay he considers as having been formed prior to the deposit of the higher members of the Huronian system, as the strata intersected are confined to the lower divisions, *a* and *b*. Mr. Howley failed to discover, in the auriferous quartz-veins of division *c*, a single example of visible gold. Some copper ores were found, mostly in divisions *a* and *b* of the Huronian system. Near Little Placentia, some argentiferous galenite occurred, which yielded, on analysis, 159 ounces of silver to the ton (2,240 pounds) of ore. Accompanying the report is an appendix with three plates, containing descriptions and figures of primordial fossils, by the late E. Billings. These figures and descriptions have already been published (*Geol. surv. Can., pal. foss.*, 1874, ii. 1). A geological map on a scale of four miles to the inch, and showing very plainly the distribution of the formations, accompanies this report; also a section-map showing the corrugations effecting the stratification of the Huronian formation near Brigus, Conception bay, on a scale of four inches to a mile, surveyed by J. P. Howley. — J. B. M. [373

Lithology.

Hunting for lost glaciers with a microscope. — Considerable work has been done in this direc[illegible] Germany and elsewhere by various observe[illegible]ork with which geologists are more or less familiar.

In the present paper the results of an extended study of the plagioclase rocks and phonolites of the Mecklenburg drift is given by one of the prominent young German lithologists, — Dr. Eugen Geinitz, of the Rostock university. Geinitz' method consists in examining thin sections of the rocks found in the drift, and comparing them with the descriptions given by the Scandinavian lithologists of rocks known *in situ* in that peninsula. In this way various basalts, diabases, gabbros, diorites, and phonolites are referred to certain localities in Sweden, whence they are supposed to have been derived. Interesting results can be obtained by such methods; but they are often uncertain, since it cannot be predicated that rocks of the same character do not exist, or have not existed, in the intermediate drift or water-covered areas.

The paper is a valuable one on account of the extended descriptions of the rocks examined. — (*Nova acta acad. leop.-carol.*, xlv. 35.) M. E. W. [374

Hypersthene-andesite. — The chief pyroxene of an apparently typical 'augite-andesite' from Buffalo Peaks, Col., was found by Whitman Cross to be hypersthene, both from its optical properties and chemical composition. The mineral was isolated for analysis by treating the rock powder with HFl, which dissolved the feldspar, glass base, and finally the augite, leaving only the hypersthene (richer in iron than augite) and ore particles. The latter, being magnetite, were separated by a small magnet. The microscopic examination of many European and American augite-andesites of the same type seems to prove that they, likewise, contain more rhombic pyroxene (hypersthene) than augite; and Cross claims that they should be separated from other andesites, and called 'hypersthene-andesites.' Nearly all other so-called augite-andesites have more of the trachytic habitus, and are so nearly related to hornblende and mica-bearing andesites, that, according to the writer, they cannot be consistently separated, and considered as a distinct group. Should the determination of hypersthene in this sub-group of the andesites be confirmed, a very interesting, widely distributed, and well defined rock-type will have been discovered. — (*Amer. journ. sc.*, Feb., 1883.) S. F. E. [375

METEOROLOGY.

Iowa weather service. — Mr. Gustavus Hinrichs has issued an almanac for 1883, under the title of Iowa weather service annual, giving, in addition to the ordinary calendar, a summary statement of the climate of Iowa, illustrated by several diagrams. The mean temperature for Iowa City is, for the winter months, 25°; for the summer, 72°. The barometer is highest in December, lowest in April and June. The winds are strongest in March and April, being mostly westerly or north-westerly in winter, often easterly in spring, southerly or calm in summer, and westerly in autumn. Besides the general cyclonic storms, Iowa has the 'blizzard,' an intensely cold, high wind following a winter thunder-storm; the tornado, commonest in June, but occurring from March to October; and the squall, a sudden north-westerly wind with heavy clouds and rain, following sultry weather with light southerly winds. Precipitation is greatest from June to August, and least in December. It is shown on monthly maps compiled from 26,082 measures from 1876 to 1880. It is least in the north-west (26″), heaviest in the south (36″) and east (38″), and seems to be "dependent on the distribution of

the timber in the State, being greatest the timber is most abundant." — W. M. D. [376

GEOGRAPHY.

(*South America.*)

Brazilian coast. — R. A. Hehl describes the physical peculiarities of this coast, between 21° and 23° south latitude, under the headings of shore-lagoons, rivers, neighboring mountain ranges, and lowlands. — (*Peterm. mittheil.*, 1882, 443.) W. M. D. [377

Fontana's unsuccessful search for Crevaux. — The Argentine expedition under Fontana, sent last July in search of the remains of Crevaux and his party, who were lost on the Pilcomayo some months earlier, has returned to Buenos Aires without any information of the unfortunate explorers. It is concluded that any expedition, to be successful, must attempt the river from its head waters, whence a voyage down stream would require only four or five months; while, in ascending the river, at least ten months would be needed, and many great difficulties would be encountered. — (*Comptes rendus soc. géogr. Paris*, 1882, 466.) W. M. D. [378

Rumor of Crevaux's survival. — M. Milhôme, a French settler in the province of Tarija, Bolivia, wrote last October that he was convinced that some of Crevaux's party were still alive, and held as slaves by the Tobas Indians. He had seen one of the party, named Zeballos, who had escaped the reported massacre, and who had seen another, named Blanco, kept as a prisoner. Moreover a cacique had brought information to Milhôme that the Indians had some white men as prisoners, and were learning the use of arms from them. — (*Compt. rend. soc. géogr. Paris*, 1883.) W. M. D. [379

(*Africa.*)

Wissmann's trip across Africa. — At a meeting of the Khedival geographical society (Cairo) on Jan. 19, Lieut. Wissmann read a paper on his recent journey across equatorial Africa, stating, that, in company with Dr. Pogge, he had left Mukenge's town in the Tushilange country on Dec. 1, 1881, and crossed an unexplored country to the eastward as far as the Arab settlement Nyangwe, on the Lualaba, arriving there April 16, 1882. The route led them across the Lulua, Muansangoma, Lubilash, and Lomani rivers; and to the east of the last they came upon the route that Cameron had followed westward nearly ten years before. None of the large lakes previously reported in this region were found or heard of, except the Munkamba, which proves to be a small lakelet hardly three miles in length. It is fed by springs, and has no outlet, and lies at an altitude of 2,230 feet, in lat. 5° 45′ S., long. 22° 55′ E. Dr. Pogge at once returned westward from Nyangwe, but has not yet been heard from. Wissmann, after staying two months on the Lualaba, started eastward by a beaten track to Lake Tanganyika, which he crossed to Udjidji, and then passed by way of Tabora to Zanzibar on Nov. 17. His entire journey from sea to sea occupied twenty-two months. — (*Athenaeum*, Feb. 3, 1883.) W. M. D. [380

Pogge and Wissmann. — B. Förster prepares for an account of the journey of these explorers across the Kongo basin and the lake-district by a review of the results of the earlier journeys in the same field by Livingstone (1852–54), Cameron (1874), Stanley (1876), and the travellers of the German-African association in the southern Kongo basin, within the last ten years. This is followed by a summary of Pogge and Wissmann's observations as far as Mukenge. — (*Ausland*, 1883, 33, 117.) W. M. D. [381

(*Atlantic Ocean.*)

Eruption of Teneriffe. — C. Piazzi Smyth learns from private advices, that for several months past there has been no snow on the upper part of the peak of Teneriffe, although the rest of the high land has been whitened, as is usual at this season, and that more recently (in January?) 'fire, like three great bonfires,' had been seen on the summit of the peak, and a lava-stream had begun to flow down it. Previous eruptions are recorded about 1582; again in 1703 from the side of the peak, giving forth lavas that threatened the town of Guimar, on the south, and destroyed Garachico and filled its bay, on the north; and, finally, in 1798, from the western side of the mountain away from the peak. — (*Nature*, Feb. 1, 1883.) W. M. D. [382

BOTANY.

Action of fungi on cane-sugar. — M. Gayon, in experimenting with Mucor circinelloides, found, that, in the absence of free oxygen, this fungus forms spherical cells, which produce alcoholic fermentation in beer-wort, grape-juice, and solutions of glucose and levulose, precisely like brewer's yeast; but, unlike that ferment, the Mucor produces no change in cane-sugar. But if a band of paper impregnated with invertine, or a fungus capable of producing invertine, as Penicillium, is introduced into a solution of cane-sugar, the Mucor is then able to produce an alcoholic fermentation. It is now known that several species of Mucor are not able to invert cane-sugar; and the same is true of Saccharomyces apiculatus. M. Gayon suggests an ingenious method of separating cane-sugar from other sugars, as in molasses, by fermenting with the Mucor, which leaves the cane-sugar unchanged and crystallizable, while, if brewer's yeast were used, all the sugar would disappear. — (*Ann. sc. nat.*, xiv. 46.) W. G. F. [383

Development of Ascomycetes. — In order to decide the question of the sexuality of the Ascomycetes, C. Fisch has studied the formation of the asci and perithecia in the Pyrenomycetes. The principal genera studied were Polystigma, Xylaria, and Claviceps. In the first-named genus he finds that there are ascogons and trichogynes, which bear a strong resemblance to the organs of the same name found by Stahl in the lichen genus Collema; but, although spermogonia exist in Polystigma, Fisch could not be certain of a union of spermatia with the trichogyne, as was seen by Stahl in Collema. In Xylaria and Claviceps, however, he could find no evidences of sexuality, and the asci arose directly from the hyphae. Adopting the view advanced by DeBary in his paper on Saprolegniaceae, Fisch inclines to the belief that in the Pyrenomycetes we have a family in which apogamy exists as a rule, although in some cases, as in Polystigma, there is a connection with families in which there is a distinct sexuality. — (*Bot. zeit.*, Dec., 1882, Nos. 49–51.) W. G. F. [384

Structure and movements of leaves. — The relations between particular structural features in certain leaves to the phenomena of nyctitropic or sleep movements, and to those of movements following shock, must receive increased attention on account of recent papers by Gardiner and Cunningham. The former gave an account of his discovery (*Quart. journ. of micr. sc.*, Oct., 1882) that the protoplasm in adjacent cells of the *pulvinus*, or cushion at the base of the petiole, of Mimosa pudica, is continuous; the continuity being maintained by protoplasmic filaments which pass through pits in the cell-walls. In a more recent paper (*Proc. roy. soc.*, Nov., 1882) Mr. Gardiner states that he has now found the same pe-

culiar structure in the leaves of Robinia and Amicia; and he hints that the cases of continuity in protoplasm are numerous, being found not only in the *pulvini* of leaves, but in stems, roots, and tubers. Hugo de Vries found, that, when fresh, uninjured cells are treated with some neutral salt (say, potassium nitrate) in progressively stronger and stronger solutions, the protoplasm steadily contracts, until, with a 10% solution, it appears as a shrunken vesicle lying in the cell-cavity. In repeating these experiments, Mr. Gardiner finds, that, in a great number of instances, the contracted protoplasmic mass is connected with the cell-wall by fine protoplasmic threads. Moreover, the connecting-threads exhibit nodal thickenings, each node presenting a most perfect spherical form; and in several cases he has seen the threads in two adjoining cells exactly opposite each other. The method of treatment for this most interesting demonstration consists in subjecting thin, fresh sections to the action of a saturated solution of picric acid, washing with alcohol, and staining with aniline blue. Mr. Cunningham's paper is known to us as yet only through an abstract (*Proc. roy. soc.*, Nov. 16). From this abstract, which has been shortened as much as is consistent with clearness, we quote the following points: "The contractile organs, which are the chief determinants of movement, are, throughout the entire series of leaves, specially characterized by the porous nature of their component tissues. The porosity is very various in degree in different cases, and, according to the extent to which it prevails, converts the entire pulvinar organs, to a greater or less degree, into masses of a spongy texture, specially fitted to allow of the ready distribution of fluid contents. In those cases where it is most highly developed, as in Mimosa pudica, the pulvinar parenchyma is composed in greater part of finely porous cells, and in some portions contains masses of cells, which, in addition to the fine pores, are provided with one or more ostiola, — rounded openings with thickened margins." Again: it is asserted that the rapidity and magnitude of the movements in individual cases bear a direct relation to the degree of development of such structural features. — G. L. G. [385

Functional differentiation in stamens. — Dr. Müller shows that some endogens possess staminal differentiations in the same flower analogous to those previously recorded in Melastomaceae. Species of Tinnantia and Commelyna are figured, in which the three upper stamens are shorter and more highly colored than the lower ones, the quantity of pollen they produce being at the same time lessened. Their function is clearly to attract insects, and supply them with food. The remaining stamens and the pistil are so situated that insects must effect crossing while collecting pollen from the short stamens. — (*Nature*, Nov. 9.) W. T. [386

ZOÖLOGY.

Coelenterates.

The nervous system of hydroids. — According to Jickeli, the ganglion-cells of Eudendrium may be seen without difficulty in a surface view of a tentacle which has been hardened in osmic acid, and stained with picrocarmine. They are granular cells, situated between the bases of the ectoderm-cells, and sending off long processes which may join processes from adjacent ganglion-cells, or they may run to nettle-cells, or in among the muscle-fibres. In some cases a process from a ganglion-cell could be traced upwards, between the ectoderm-cells, to a small, spindle-shaped 'sensory cell' near the surface. The ganglion-cells are most easily seen on the tentacles; but they are also found on the body, the hypostom, and the glandular ring around the base. They are especially abundant in the stem of Eudendrium; and Jickeli believes that those found in the hydranth are developed in the stem. On the hydranth the ganglion-cells are sometimes aggregated in groups, and there is an indefinite nerve-ring around the base of the body. Jickeli has also succeeded in detecting the ganglion-cells of Hydra, although they are by no means so conspicuous as they are in Eudendrium. They are less granular, the nucleus is much larger, and the processes are more numerous. They are found in the ectoderm of all parts of the body, and they are usually situated among the groups of nettle-cells. — (*Zool. anz.*, no. 102; *Morph. jahrb.*, viii. 380.) W. K. B. [387

Histology of hydroids. — In addition to his interesting account of the nerve-cells of Eudendrium and Hydra, Jickeli describes other histological features of these two genera, especially the gland-cells and nettle-cells. In Eudendrium, the nettle-cells are most abundant in the stem; and he believes that this is the only place where new ones are formed, and that each hydranth receives its full share when it is formed as a bud. In Hydra each nettle-capsule is almost enclosed by a nucleated cell, which corresponds to the network of muscular fibres described by Chun in the Siphonopherae, and which sends muscular processes into the layer of muscle-fibres formed by the ordinary epithelio-muscular cells.

He points out the fact that the various species of Hydra may be identified by their nettle-cells alone.

The paper also contains a discussion of Kleinenberg's *neuro-muscular* cell theory, and a bibliography of the minute anatomy of hydroids. — (*Morph. jahrb.*, viii. 373.) W. K. B. [388

Crustaceans.

Breaks in the exoskeleton of decapod Crustacea at the time of moulting. — The apodemes of the exoskeleton, which form the sternal canal enclosing the chain of nervous ganglia in the Macrura, cannot be shed entire at the time of exuviation, as they have been said to be, without breaking the principal cords of the nervous system; and F. Mocquard finds, on examining the exuviae of Palinurus and the common lobster, that there is, in fact, a solution of the continuity of the apodemes along the median line at the time of moulting. He has not examined exuviae of Brachyura, where there is no proper sternal canal, but observes that the disposition of the venous sinuses necessitates the rupture of the apodemes at the time of moulting. — (*Comptes rendus*, Jan. 15, 1883.) S. I. S. [389

Origin of the species of Ocypoda from the Bonin islands. — Among some specimens of Ocypoda from the Bonin islands, Mr. Ishikawa is quite certain he sees 'specific differentiation going on before our eyes' in the varying length of the ocular stylet, and some other slight differences. The specimens are said to be closely allied to O. arenaria; but the figures which accompany the paper show that they are really very different, that they probably belong to two well-known Pacific-ocean species (O. ceratophthalma and O. cordimana), and that the supposed 'stepping-stones' between the two forms are only well-known variations of the former species due mostly to age and sex. — (*Amer. nat.*, Feb., 1883.) S. I. S. [390

Insects.

Habits of the basket-worm. — Prof. William Macfarland called attention to two important facts in the history of Thyridopteryx ephemeraeformis. When large trees are inhabited by them, only the small ends

of the twigs become their winter habitat. The arbor-vitae, and small trees with many slender branches, are their favorite resorts, and, when once attacked, are frequently destroyed. After the basket is well constructed, they have few enemies; but so persistent are these few that they nearly exterminate the basket-worm. At least seventy-five per cent are annually consumed by very small ichneumon flies, about one-eighth of an inch in length. Only about five per cent of those opened had ovaries filled with eggs.

Most of the T. ephemeraeformis thus infested with parasites are pupae; but some are found in the imago state, when the eggs have become the favorite food, and are wholly consumed.

There is only one brood annually; and, from what has been observed, it is quite evident that all shrubs and trees may be ridded of these pests by picking the cases off during the winter or early spring. — (*Trenton nat. hist. soc.; meeting* Feb. 13.) [391

Fertile eggs from a dead moth. — Mr. F. G. Schaupp states that last July he captured a ♀ of Arctia virgo, and obtained about a dozen eggs. As the specimen was useless for the cabinet, having lost half a wing, he dissected the abdomen, and found about fifty eggs therein, sticking together. After washing them with tepid water, he put them in a hatching-box, and in due time about twenty young larvae made their appearance. Could the same thing not be done when capturing a poor ♀ of a rare species? — (*Brookl. ent. soc.; meeting* Feb. 3.) [392

VERTEBRATES.

Relation of spinal-cord nerve-cells to fibres in the spinal nerves. — A careful enumeration of the large 'motor cells' in the anterior cornua of the spinal cord of the frog, and of the number of nerve-fibres in the anterior and posterior roots of the spinal nerves, has been made by Birge. He finds that there are just as many motor cells in the cord as fibres in the anterior roots, and that in regions where the fibres joining the cord are numerous, the motor cells are proportionately increased in number. When an individual shows some abnormality in the distribution of nerve-fibres between its anterior roots, a corresponding irregularity is found in the cells of the anterior cornua. It is therefore almost certain, that each motor nerve-fibre has its own single nerve-cell as its central organ, and that these cells lie in the spinal cord near the level at which their fibres join it. As the frog grows, the number of nerve-cells in the anterior horns of the gray matter, and the number of fibres in the anterior spinal roots, increases, proving a continued development of motor cells and motor fibres as the muscles increase in mass.

In any given specimen the fibres in the sensory roots are more numerous than those in the motor. The sum of the fibres in the anterior and posterior roots of a spinal nerve is equal to the number of fibres in the common trunk formed by their union beyond the ganglion of the posterior root. Hence, in traversing its ganglion, the sensory root experiences no increase or diminution in the number of its nerve-fibres. — (*DuBois' Archiv.*, 1882, 435.) H. N. M. [393

Irritability of motor-nerve cells in the spinal cord. — If parts of the spinal cord of the frog be cut or pricked, tetanus occurs in certain groups of muscles. Such tetanus does not follow cutting or pricking a nerve-trunk. Working with special apparatus, and with methods making it possible to ascertain exactly what part of the spinal cord was pricked, Birge finds that in the region of the spinal cord from which the sciatic plexus originates, the insertion of a needle-point only causes tetanus (with rare exceptions) when the needle has passed through the region of the gray matter in which the motor cells lie. Pricking the gray matter elsewhere has no effect on the muscles, or only causes a 'twitch' instead of a tetanic contraction. He concludes that the motor cells are capable of direct mechanical stimulation, and that a momentary stimulus throws them into a state of activity which lasts longer than the application of the stimulus. As his previous work (see 393) had made it pretty certain that each motor fibre ended in one definite motor spinal-cord nerve-cell, he concludes that any normal stimulus (voluntary or reflex), acting in the ordinary working of the body on the motor cells of the spinal cord, will, no matter how transient it may be, cause, not a twitch, but a tetanic muscular contraction of longer or shorter duration. — (*DuBois' Archiv.*, 1882, 481.) H. N. M. [394

Influence of respiratory movements on arterial pressure. — In a previous work Schweinberg had shown that in dogs the normal respiratory variations of arterial pressure disappeared upon cutting the phrenics. He concluded that the variations were due to changes of intra-abdominal pressure, dependent on diaphragmatic contractions and relaxations. If this be so, the respiratory curves of arterial pressure ought to disappear even with intact phrenics, if all circulation through the abdominal arteries be prevented: this Schweinberg finds to be the case. When the thoracic aorta is tied above the diaphragm through an opening made in the back of the thorax with care to leave the pleurae intact, then, unless the breathing becomes forced and abnormal, all the respiratory variations of arterial pressure cease. — (*Arch. für physiol.*, 1882, 540.) H. N. M. [395

The fatigue curve of striated muscle. — A short paper on this subject by Valentin contains as its chief novelty the fact that repeated feeble exercises of functional activity by a frog's muscle through which no blood is circulating aid in restoring the fatigued organ, so that subsequent contractions become more powerful. — (*Pflüg. arch.*, xxix. 506.) H. N. M. [396

Birds.

Germinal disk of birds. — Gasser has published an article containing several matters of interest. He first supplements his previous observations on the neurenteric canal, and reviews Kupffer's work. He still maintains that in birds "the primitive groove first becomes distinct on the anterior part of the primitive streak, and there becomes deepest; this deepest part corresponds to the spot where in many bird embryos the perforation of the neurenteric canal subsequently occurs." He then passes to the consideration of Koller's investigations, whose conclusion is, that the primitive streak is normally preceded by a '*sichel*' (a crescent-shaped thickening of the inner germ layer on the edge of the *area pellucida*). On the contrary, Gasser maintains that the '*randwulst*' is thicker behind than in front, and the thickened portion may present sometimes in surface views the figure of a crescent, and that a *sichel* as a structure distinct from the *randwulst* is not proved by Koller to exist. Further Gasser argues against Koller's assertion that the primitive streak grows forward out of the supposed *sichel;* and he declines to admit any morphological importance for the groove, which is occasionally found in the *randwulst* (Koller's *sichel*), and upon which Koller lays such stress. Next follows a brief notice of Balfour and Deighton's paper. The remainder of the article is occupied by the author's own recent investigations on the chick, goose, and dove,

concerning the origin of the primitive streak. In a series of five chick-embryos, 5–8¾ hours incubation, the first important development noted was in the entoderm, which in the front part of the *area pellucida* remains thin, while in the posterior part it is thickened, until at the edge of the *opaca* behind it is five or six layers of cells thick. In the next stage there is a short primitive streak (but without its cephalic process) within the *area pellucida*, and formed essentially by the thickened outer germ-layer. The inner layer now includes both mesodermic and entodermic elements, and does not correspond to the definite entoderm of later stages. Around the edge of the germinal disc the upper layer bends over, and is united with the inner layer; the bend marks the germinal wall and later *randwulst*, which is thickened posteriorly, forming Koller's *sichel*, which is not a distinct structure. The inner layer forms one mass with the germinal wall, and it is probable that the latter furnishes the cells to thicken the former. The thickening of the inner layer may be best interpreted as a step towards the formation of the mesoderm. Gasser also reports in detail his observations on the goose and dove. Unfortunately the memoir is without plates, and contains no summary of the author's conclusions. — (*Arch. f. anat. physiol.; anat. abth.*, 1882, 359.) C. S. M. [397

Colors of feathers.— In continuation of previous communications Dr. Hans Gadow discusses the colors which are not the result of pigments: blues he considers to be the result chiefly of a series of fine lines on the walls of the prism cells; greens as the result, most often, of decomposition of light from a yellow pigment; metallic feathers are considered to work on the simple principle of a prism. — (*Proc. zoöl. soc. Lond.*, 1882, iii.) J. A. J. [398

Mammals.

Notochord of mammals. — Strahl in the paper above noticed showed that the neurenteric canal appears in the anterior end of the primitive streak, and that its wall is concerned in the formation of the notochord. His observations refer to lizards. Lieberkühn has found a canal in guinea-pig embryos, which occupies a similar position, and leads to the formation of the notochord (*chorda dorsalis*). This canal is, therefore, probably homologous with that of lizards, although it is developed in the interior of the mesoderm without connection with the ectoderm. Lieberkühn's views on the early development of mammals may be summarized as follows: After the completion of segmentation, fluid accumulates between the outer cell layer and the inner cells in such manner that the latter finally mark out the embryonic disk, which accordingly consists of the outside covering of flattened cells (ectoderm), and the inner layers of round yolk cells (entoderm). The entoderm then grows on all sides, and becomes thinner. The flattening-out of the ectoderm is evidently a rather complicated process, which Lieberkühn tries to elucidate, following Balfour (*Comp. embryol.*, ii. 181, 182). Next appears the mesoderm, before the primitive streak becomes visible. The cells of the middle layer appear between the two primitive layers, at first at the posterior end of the disk. They are certainly derived in part from the ectoderm, and very probably in part also from the entoderm, since in the region of the primitive streak the three layers are not limited one from another. Yet at first the mesoderm appears in the mole as a simple layer of cells between ento- and ectoderm. The primitive streak is a thickening of the mesoderm, and terminates anteriorly in a special thickening known as the cephalic process. This appears in guinea-pigs on the thirteenth day. The mesoderm in the process is entirely separated from the ectoderm, which rises in a slight convexity over it. The passage of the adherent (mesodermic) primitive streak to the free 'process' is known as Hensen's knot, it being marked later by a slight enlargement. The process grows forward; and at the time it reaches the dark edge of the disk a longitudinal canal appears in the midst of it, short at first, but rapidly elongating. The canal subsequently breaks through into the entoderm; the opening gradually, but irregularly, extends the length of the canal, which thus becomes, as it were, a trough or furrow in the dorsal wall of the entoderm. The cells of the canal are cylindrical and high; the furrow flattens out, and its wall then appears a constituent part of the entoderm. This stage has been seen by previous observers. By the time the canal is opened about to the middle of the germinal disk, the formation of the medullary groove begins. In the next stage Hensen's knot is relatively nearer the posterior end of the disk. The protovertebrae appear. By the time there are four, the chordal canal continues to grow backward in the primitive streak in the same manner as at first; but at the posterior end the differentiation of the chorda no longer precedes, but follows, that of the medulla and intestine. The manner in which the notochord becomes finally separated from the entoderm has been accurately described in other publications. (The author's text and plates are arranged in inexcusable confusion. Those who wish to read the original are counselled to begin with a careful study of the explanation of the plates.) — (*Arch. anat. physiol.; anat. abth.*, 1882, 399.) C. S. M. [399

Foetal envelopes of Chiroptera. — According to Robin, the foetal envelopes of the Phyllostomidae resemble rather those of the rodents than of other Chiroptera. — (*Comptes rendus*, Dec. 26, 1882.) C. S. M. [400

The evolution of deer-antlers, and atavism in the hog-deer. — A pair of antlers of the hog-deer (Axis porcinus) is described by J. Cockburn, in which the left horn bears five tines. The first two are normal; the third is bent inward and backward; the fourth and fifth correspond somewhat closely to the 'royal' and 'sur-royal' of the Wapiti (Alces canadensis). Caton's opinion that such unusual forms are due to accident is not concurred in, the present and other similar cases being explained by atavism.

Garrod's law, according to which the typical antler consists of a bifurcated beam, with a brow-antler near the base, is set aside in favor of Dawkin's theorem, which is recast in the following words: "The development of the antlers of individual species of cervines is a recapitulation of the history of the development of antlers in the group." The typical or primeval antler, according to Cockburn, is a simple spike, "capable of extensive furcation, reduplication, arrest and redundancy of growth in parts." An attempt is made to explain the form of the antlers of various species of deer according to this theory. — (*Journ. Asiat. soc. Bengal*, li., 1882, 44.) F. W. T. [401

Behavior of the American flying-squirrel in confinement. — Mr. F. H. King, who kept three young flying-squirreis (*Sciuropterus volucella*) in confinement for several months, gives an interesting account of their actions. They were strictly nocturnal, assuming an especially playful mood at 10.45 P.M. and 3.30 A.M., which, in each case, lasted an hour or more. When on the wing, and just prior to alighting, the fore-limbs were made to vibrate as if in true flight. One of the specimens, having broken a hind-leg,

strongly objected to the splints which were applied, and cut them loose at once; but soon after, it submitted to the treatment a second time with grace, and made no effort to free himself. Nuts were the favorite food; but animal food was not always rejected. Acorns, when first offered, aroused remarkable emotion, and an effort was made to bury them. After they were added to the *menu*, all other nuts were rejected, except hazel-nuts. The squirrels, when taken, were too young to have had any experience in storing nuts. The chief pet did not fail to recognize Mr. King after an absence of three months. — (*Amer. nat.*, 1883, 36.) F. W. T. [402

Taxonomy of the hoofed quadrupeds. — E. D. Cope, taking cognizance of both living and extinct forms, emphasizes the taxonomic value of the arrangement of the carpal and tarsal bones. He recognizes the following orders and suborders: Taxeopoda, including suborders Hyracoidea and Condylarthra; Proboscidea, including suborders Proboscidea and (probably) Toxodontia; Amblypoda, including suborders Pantodonta and Dinocerata; and Diplarthra (equals Ungulata of most writers), including suborders Perissodactyla and Artiodactyla. The forms in which the two rows of carpal and tarsal bones do not alternate are mostly extinct, while those in which they do alternate have endured. The Perissodactyla and Artiodactyla, as well as the Proboscidea, are regarded as descendants of the Taxeopoda, representing different branches of that order. — (*Proc. Amer. philos. soc.*, xx., 1882, 238.) F. W. T. [403

A mole pursues an earthworm to the surface of the ground, and drags it below (F. Lang). — (*Zoölogist* (3), vii. 76.) F. W. T. [404

ANTHROPOLOGY.

Michlucho Maclay's travels. — Our readers will recall the charming letters we used to read a year or two ago from this distinguished traveller, and will be pleased to learn that he has resumed the publication of his researches by a series of lectures before the Russian geographical society. He has brought home from New Guinea and the Malacca peninsula both objects and drawings illustrative of the person, dress, implements, dwellings, activities, social life, and religion of the natives.

The natives of the north-west coast are at the lowest stage of culture. Before Mr. Maclay's visit, they used only implements of stone, bone, and wood, and knew not how to make fire. They do not bury their dead, but place the corpse in a sitting position, and, having covered it with palm-leaves, dry it by means of fires. There is but one race of Papuans, those of the interior belonging to the same race as those of the coast. Both dolichocephalic and brachycephalic crania have their representatives among the purest Papuans of the Malay coast; the transversal diameter of the Papuan skulls varies from 62 to 86 per cent of the length. The clustered hair often insisted on by many writers does not exist among Papuans, not even among children. Furthermore, the size of the curls is no criterion of distinction between the Papuans and Negritos. The method of race mixture is very well explained in the traffic in girls carried on between Celebes and New Guinea. At Port Maresby (Anapuata) on the southern coast, a mixture of Polynesian blood among the Papuans was noticed. These Metis have a lighter skin and uncurled hair, and practise tattooing. The women tattoo themselves from the forehead to the feet, and often shave the head to tattoo it. The men are marked only to exhibit some of their exploits. Mr. Maclay made five visits to New Guinea, and the full account of his work will be eagerly looked for.

In a subsequent communication Mr. Maclay reported his extended travels, full of most valuable information, in the Malay peninsula, and among the islands of Malaysia, Micronesia, and Melanesia, as well as in Australia. — (*Nature*, Dec. 7, 21.) [405

Documentary history of New York. — Those who have had occasion to study the Indians of eastern United States during the colonial period will recall the invaluable help they received from the ten ponderous volumes of the Documentary history of New York, compiled by Mr. O'Callahan. It is not to these that we wish to recall attention, but to the thirteenth volume of the series, just received, containing documents relating to the history and settlements of the towns along the Hudson and Mohawk rivers, from 1630 to 1684, and also illustrating the relations of the settlers with the Indians, translated and edited by B. Fernow, keeper of the historical records. The work is prefaced by a letter from Joseph B. Carr, secretary of state, and concludes with an appendix by Dr. J. G. Shea, being an extract from the narrative of the captivity of Father Isaac Jaques, among the Mohawks in 1642 and 1643. A complete table of contents and a good index leave nothing to be desired in the way of perfecting the volume. — J. W. P. [406

Urgent need in anthropology. — Mr. William L. Distant writes to *Nature*, that, while zoölogy and geology have each a yearly 'record,' anthropology still remains without that aid to its proper advancement. The bibliographies of the German publications, and of Prof. O. T. Mason in the *Naturalist*, are referred to. It would be well for those interested in such matters, while waiting for a more systematic annual test, to keep a close lookout for the *Revue d'anthropologie*, the more extended bibliography of American anthropology by Mr. Mason, in the Smithsonian Annual Report, and especially for the *Index medicus*, published in Washington. In the last-named periodical, under the words, 'biology,' 'physiology,' 'craniology,' and 'anthropology,' will be found the titles of almost all the best productions upon anthropology. — (*Nature*, Nov. 30, 1882.) J. W. P. [407

Cannibalism in New England. — Mr. Henry W. Haynes has discovered evidences of this horrid custom on the coast of Maine. The shell-heaps of Mount Desert and vicinity yield the evidence; and the people who practised the eating of their fellow-mortals were the ancient aborigines. The author cites other writers as witnesses to the fact. — (*Proc. Boston soc. nat. hist.*, xxii.) [408

EARLY INSTITUTIONS.

Universities. — In a rectorial address to the students at Aberdeen, Alexander Bain describes the history of universities and the university ideal. It is interesting to read this in connection with the address of Dr. Behrend at Greifswald, in the *Deutsche rundschau* of last December. — (*Pop. sc. monthly*, Feb., 1883.) D. W. R. [409

The early Germans. — R. Schröder sums up the conclusions of Louis Erhardt, *Aelteste germanische staatenbildung* (Leipzig, 1879), as follows: 1°, Germanic origin of the Nervii, Treviri, and other Belgic peoples; 2°, many small kingdoms (*pagi*) among the Germans; 3°, each kingdom governed by a king and senate of a hundred members (*centeni ex plebe comites*); 4°, the *pagi* of Caesar and Tacitus must not be confounded with the later hundreds. — (*Hist. zeitschr.*, 6 heft, 1882.) D. W. R. [410

Statistics of population. — Dr. H. Paasche writes regarding the population of the cities of western Europe during the middle ages, that, even as late as the seventeenth century, no regular estimates of population were made. Nobody cared for statistics of this sort: consequently there is a gap in our knowledge of economic and social life of those times, which can only be filled up by reasoning from incidental items in town and city records. The writer takes up the history of Rostock in the fifteenth and sixteenth centuries, and shows how this may be done. — (*Jahrb. nat.-ökon. statist.*, Nov. 15, 1882.) D. W. R. [411

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Coast and geodetic survey.

Recent deep-sea soundings of unusual depth. — In the prosecution of recent deep-sea soundings off the West-Indian islands by the U. S. steamer 'Blake' (Lieut.-Comdr. W. H. Brownson, U.S.N., commanding), for the purpose of ascertaining the extent of the continental plateau and the border of the oceanic basin, some extraordinary depths have been reached, and successfully measured by the method of wire-sounding; the specimen-cup and thermometers having been brought up from depths exceeding five miles.

The following extracts from the report of Lieut.-Comdr. Brownson, addressed to Prof. J. E. Hilgard, superintendent of the survey, will be of general public interest. It is written from St. Thomas, under date of Jan. 29, 1883.

"I enclose, herewith, approximate positions of soundings taken on lines, first, from Mariguana to Ocean plateau, thence down through Turks island passage to coast of Hayti, — second line from Samana promontory to Navidad bank, — and thence out to Ocean plateau. . . . From an inspection of the chart to the northward of this island, in connection with the result obtained by me on last line, and the soundings taken by Sir George Nares in the 'Challenger,' I thought it more than probable that the deep water found by him (3,875 fathoms) would extend to the westward. . . .

"On the 27th inst., in lat. 19° 40′ 50″, long. 66° 23′ 40″, seventy-one miles west of 'Challenger's' greatest depth, with long rolling sea, fresh trade-winds, with frequent squalls of wind and rain, sounded in 4,561 fathoms. In reeling in, cross-heads of sounding-machine showed great strain on wire: so shipped cranks to assist reeling-engine over the centre to prevent sudden strain on wire; and, by using every care to ease the strain, we succeeded in recovering the sounding-rod and thermometer. The bottom was brown ooze; temperature 36¼° F.

"Fifteen and a half miles south-east of the latter station sounded again in 4,223 fathoms, bottom of two layers of ooze, brown on top, with under-strata of gray; temperature 36°. When the wire was nearly in, the reel showed signs of being crushed, cracking in several places; but fortunately it did not give way. With the last sounding, two bottom-thermometers were sent down, — a Miller Casella No. 49,406, and a Tagliabue No. 531. The latter came up crushed by the excessive pressure. The reading of the Miller Casella I have no reason to doubt.

"I doubt if the sounding machine and wire has ever before successfully withstood so great a strain.

"In the soundings taken by Capt. Belknap in the Pacific, in no case that I can find were the sounding-rod and bottom-thermometer recovered in over 4,356 fathoms.

"In the second sounding, the wind had freshened considerably, and there was a short ugly sea in addition to the long swell."

Geological survey.

The Grand Cañon Group. — Marble Cañon and the Grand Cañon constitute together a continuous gorge, through which the Colorado river courses for 250 miles. The walls of the gorge are not sheer precipices, but are terraced on a grand scale; the succession of platforms and cliffs being determined by the succession of strata, which, for the most part, lie horizontal. The top of the wall is everywhere upper carboniferous; and thence downward for about 4,000 feet there is a nearly uniform system of paleozoic rocks, conformable in dip. The principal member of this conformable series is so massive that the cliff formed by it is unscalable at nearly all points; so that almost the only access to the depths of the gorge has been by boats. In Major Powell's first exploration of the Colorado, he discovered at the head of the Grand Cañon, where the gorge is deepest, a system of inclined rocks which had been greatly eroded before the deposition of the conformable series. These unconformable rocks, which he named the *Grand Cañon Group*, rest in turn upon schistose and granitoid rocks having the general facies of the archean. The difficulties of the voyage, and especially the exhaustion of supplies, rendered it impossible for him to make extended search for fossils; and, in lack of paleontologic evidence, he assigned the Grand Cañon Group provisionally to the Silurian, and referred the whole of the conforming series above it to the carboniferous. Mr. Gilbert, examining soon after the section at the lower end of the gorge, discovered no unconformity, except that between the metamorphic and non-metamorphic rocks; and, finding Cruziana in the lowest member of the unaltered rocks, he referred it provisionally to the lower Silurian. He named this member the *Tonto Group*. Still later Mr. C. D. Walcott, making a careful study of the section at an intermediate point, discovered an unconformity by erosion above the Tonto, and at the same time obtained additional fossils which served definitely to place the Tonto in the Cambrian. The question then arose, whether the unconformity by erosion, observed by Walcott, was the equivalent of the unconformity by dip observed by Powell. If it was, then in Powell's section the Tonto lay immediately above the archean, and the Grand Cañon Group was Cambrian. If it was not, then the Tonto was to be found at the base of Powell's conforming series, and the Grand Cañon Group was Pre-Cambrian. For the sake of settling this question, and at the same time of exploring the Pre-Cambrian rocks, if such they should prove to be, Major Powell, last autumn, made an excursion to the locality, with great difficulty constructing a horse-trail from the upper plateau to the brink of the river, where the rocks are best exposed. He found the Tonto at the base of the upper series, and thus demonstrated the Pre-Cambrian age of the Grand Cañon Group. The rocks being unmetamorphosed, and the series having a thickness of more than ten thousand feet, there is great reason to hope that they will prove fossiliferous, and thus add a prefatory chapter to the

geological record. Mr. Walcott, who accompanied Major Powell, remained on the ground to search for fossils, and has not yet completed his examination. If he discovers them, his report will be eagerly received alike by geologists and biologists.

NOTES AND NEWS.

— Professor Felipe Poey of Havana, under date of the 24th of January, 1883, announces that the Spanish government has purchased his *Ichthyologia cubana* for $4,000. It will be exhibited in the exposition in Amsterdam. He hopes to have it printed in Madrid. The work is in ten volumes, each 4½ by 3¼ decimetres. They contain 1,040 plates of fishes of every period of growth. The drawings were made by himself from the life. Many of the plates occupy three, and even six, double pages. About half fill only one single page each.

The plates represent 758 species of Cuban fishes (1,300 individuals), 90 scales, 94 vertical sections, 87 entire skeletons, 51 half-skeletons, 43 details of skeletons, 85 complete visceras, 32 details of visceras, 8 entozoa, 120 miscellanea.

— The addresses at the memorial meeting last October in honor of the late Prof. W. B. Rogers, the founder of the Massachusetts institute of technology, have been appropriately published by the Society of arts of the institute in a separate pamphlet. An excellent portrait, apparently from a photograph taken about five years ago, reproduced in heliotypy, accompanies the pamphlet. The addresses were of unusual interest, and well illustrate the breadth and catholicity of Professor Rogers's life. Perhaps the most interesting to the Boston audience were the remarks, toward the close of the meeting, by Major Hotchkiss of Virginia, who spoke of his earlier life in the South. We quote the following passage: —

"All over the state of Virginia, even now, you will continually meet people in the country — old men and old women — who recollect the days when Professor Rogers drove up with his gig, with Levi, his negro servant, behind him on horseback, accompanying him in his geological rambles — recollect with pleasure that familiar lecture in the morning from the doorstep; for he never went away without leaving with each one that he visited a new vision of that which before they had seen with sealed eyes, that it was his delight to unseal. One of the best of our living structural geologists, one of that same Scotch-Irish race, when a flaxen-haired boy, heard Professor Rogers describe to a group of listeners one of the grand arches of one of Virginia's mountain ranges, when, stooping down, like another great teacher, he wrote its structure in the sand, but wrote for all time. . . .

"It would furnish material for a singular study, — that primal geological circle. Levi, the negro serving-man, was in it. He became a geologist. He learned to think as his master thought. And when the great French geologist, Daubeny, came to visit Professor Rogers . . . Levi drove him; and, as they rode through the grand sections of Appalachian structure there displayed, Levi gave him lessons in American geology. 'Dis, sar,' said he, 'we call number one. Mighty fine *crap* (out-crop) ob it 'long here.' He had so well learned the lesson from the great master of American geology, he could teach it to the one of French."

— The international geological congress at Bologna in 1881 appointed a commission to prepare a map of Europe, and the following particulars have now been agreed upon: the topographic basis will be prepared by Kiepert, and published by Reimer & Co. at Berlin, but with French wording. It will consist of 49 sheets on a scale of 1:1,500,000, the whole measuring 3.72 by 3.36 metres. Mountain shading will be omitted. 900 copies have been engaged by various governments, and thus the price has been brought down to the reasonable figure of 100 francs. Although some six years will be needed for its completion, those who wish copies are requested to subscribe at once.

— The Archaeological institute of America now numbers about 80 life, and 220 annual members, and, besides its Reports and its Papers (of two series), has commenced the publication of a Bulletin, the first number of which gives a statement by the executive committee of the work of the institute in 1882, as far as regards the undertakings at Assos; a report by Mr. Bandelier on his investigations in New Mexico in the same year; and a note by Mr. Ludlow on a terra-cotta figurine of a centaur from Cyprus, interesting as having human fore-legs like those found in the sculpturings of the epistyle of the temple at Assos by the expedition of the institute. Mr. Diller, we learn from the committee's report, spent the greater part of his vacation last year in continuing his studies of the geology of the Troad.

The paper by Mr. Bandelier is the longest, the most important, and of the largest interest to scientific readers. He reaches the conclusion that the present condition of the Pueblo Indians is not their original one, but has been largely affected by contact with the whites, and that there were only two types of aboriginal architecture in New Mexico, — "the many-storied communal house, and the one-story building of stone." He contrasts, also, the 'cacique' of to-day and that of the old Spanish authors.

Interest in the work of the institute will be increased by the timelier publication of results which the establishment of the Bulletin will permit.

— The Cincinnati society of natural history celebrated the birthday of Charles Darwin on Feb. 23. Prof. A. G. Wetherby delivered an address on the Influence of Darwinism upon science, which was followed by an exhibition of microscopes. The reception had to be postponed from the 12th, owing to the flood in the Ohio, and the consequent stoppage of the gas-works.

— In the article The glacial theory before the Philadelphia academy (SCIENCE, p. 97), the statement occurs that "the greatest snow-clad elevation in Greenland is Washington Land." The author wishes this changed to "the greatest snow-clad elevation *in the region of greatest cold* (the west) in Greenland," etc.